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A TUTOR TO Aſtronomy and Geography.

Or, an eaſie and ſpeedy way to know the USE of both the

GLOBES,

Cæleſtial and *Terreſtrial*.

In Six BOOKS.

The
1. Teaching the Rudiments of *Aſtronomy* and *Geography*
2. Shewing by the GLOBES the ſolution of *Aſtronomical* and *Geographical* Problemes.
3. Shewing by the GLOBES the ſolution of Problemes in *Navigation*.
4. Shewing by the GLOBES the ſolution of *Aſtrological* Problemes.
5. Shewing by the GLOBES the ſolution of *Gnomonical* Problemes.
6. Shewing by the GLOBES the ſolution of *Trigonometrical* Problemes.

More fully and amply than hath been ſet forth, either by *Gemna Friſius*, *Metius*, *Hues*, *Wright*, *Blaew*, or any others that have taught the Uſe of the GLOBES: And that ſo Plainly and Methodically, that the meaneſt Capacity may at firſt Reading apprehend it, and with a little Practice grow expert in theſe Divine Sciences.

With an APPENDIX ſhewing the Uſe of the *Ptolomaick Sphere*.

The Fifth Edition Corrected and Enlarged.

By JOSEPH MOXON.

Whereunto is added the Antient *Poetical Stories of the Stars*; ſhewing **Reaſons why the ſeveral Shapes and Forms are pictured on the *Cæleſtial Globe*.**

As alſo a Diſcourſe of the *Antiquity*, *Progreſs* and *Augmentation* of *Aſtronomy*.

Job XXVI. 7. 13.

He ſtretcheth out the North over the empty place, and hangeth the Earth upon nothing.
By his Spirit he hath garniſhed the Heavens, His hand hath framed the crooked Serpent.

LONDON,
Printed for *James Moxon*, at the ſign of *Atlas* in *Warwick-Lane*, MDCXCVIII.

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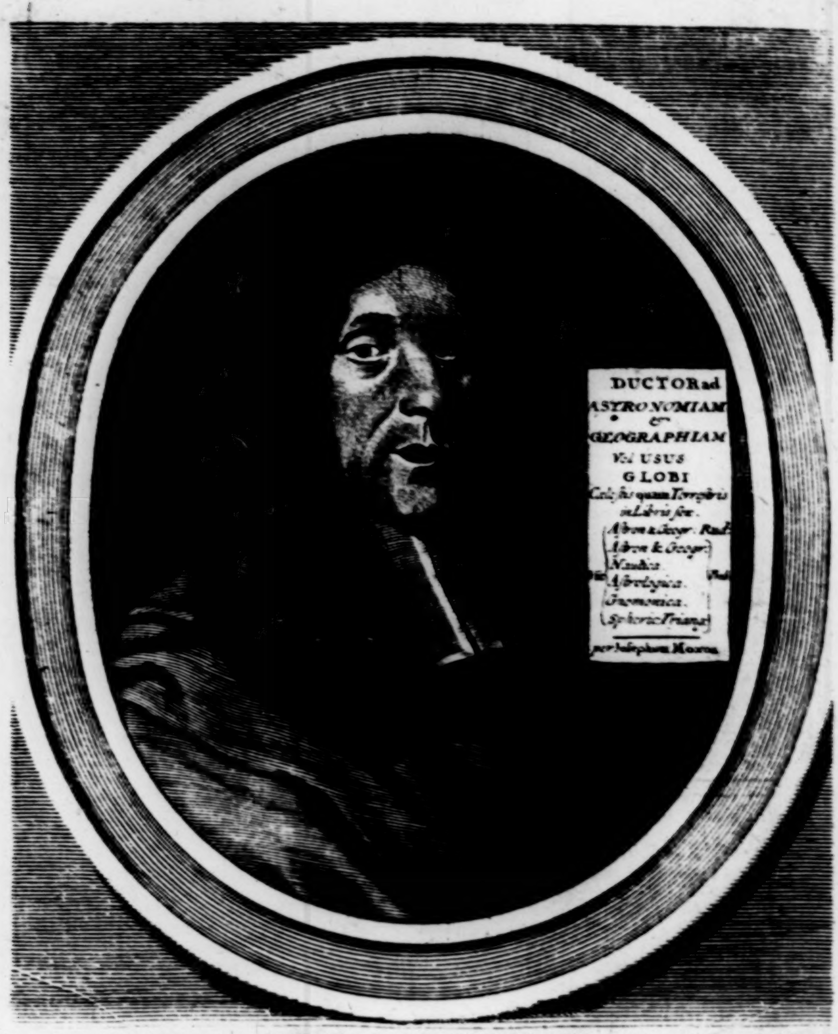
DUCTOR ad
ASTRONOMIAM
&
GEOGRAPHIAM
Vel USUS
GLOBI
Cœleſtis quam Terreſtris
in Libris ſex.
Aſtron & Geogr. Rud.
Aſtron & Geogr.
Nautica.
Aſtrologica.
Gnomonica.
Sphæric Triang.
per Joſephum Moxon

Joſeph Moxon.
Born at Wakefeild Auguſt 8
Anno 1627.

1651/514.

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To His Excellency

THOMAS,

Earl of Pembrook *and* Montgomery, *Baron* Herbert *of* Cardiff, *Lord* Roſs *of* Kendall, Par, Marmion, St. Quintin *and* Shurland: *One of the Lords Juſtices of* England, *Lord* Privy Seal: *Lord Lieutenant of the County of* Wilts, *and of* South Wales: *And One of His Majeſty's Moſt Honourable* Privy Council

May it pleaſe Your **EXCELLENCY**.

ALthough Your Exaltation (ſo worthy Your Merit) is to the higheſt Dignity, and Greateſt Truſt, that a moſt Gracious Sovereign could Confer upon your Excellency; yet Your Motion is not in ſo high a Sphear, but that the Benignity of Your Influence is extenſive to the minuteſt Performances, and whatever can come under the Denomination of Solid and Uſeful Learning, and that to ſuch a Degree, that I muſt be taxed much more with Modeſty in forbearing

ring, than I can poſſibly be with either Vanity, or Flattery, in Saluting your Excellency with the Title of the Mæcenas of our Age. *Wherefore in a firm Aſſurance hereof, and as a Teſtimony of my humble Reſpects to your Excellency, I cannot pretermit this Opportunity of preſenting You with the* Fifth Impreſſion *of the Uſe of the* Cœleſtial *and* Terreſtrial Globes, *in the beſt Perfection it has hitherto appear'd in the World, and humbly Craving Your Patronage both of it, and him, who is*

Your EXCELLENCY'*s*

Moſt Humble and

Obedient Servant

J. Moxon.

To the Reader.

Courteous Reader.

THe Globes *is the firſt Study a Learner ought to undertake, for without a competent apprehenſion of them he will not be able to underſtand any Author, either in* Aſtronomy, Aſtrology, Navigation, *or* Trigonometry: *Therefore my aim in this Book hath been to make the Uſe of them very plain, and eaſie to the meaneſt Capacities: In proſecution of which Deſign, I doubt not the Learneder ſort may be apt to Cenſure me guilty of Prolixity, if not Tautology: Becauſe the precepts being plain, they may account ſome of the Examples Uſeleſs. But I deſire them to conſider, that I write not to expert Practitioners, but to Learners; to whom Examples may prove more Inſtructive than Precepts. Beſides, I hope to encourage thoſe by an ample liberal plainneſs, to fall in Love with the Studies, that formerly have been diſheartned by the Crabbed brevity of thoſe Authors that have (in Characters as it were rather writ Notes for their own Memories, than ſufficient Documents for their Reader's Inſtructions.*

The Globes for which thisBook is written are new Globes that I ſet forth, which, as I told you in my Epiſtle to the Reader of Blaws *Book, differs ſomewhat from other Globes; and that both the* Cœleſtial *and the* Terreſtrial, *mine being the lateſt done of any, and to the accompliſhing of which I have not only had the help of all, or moſt of the beſt of other Globes, Maps, Platts, and Sea-drafts of New diſcoveries that were then extant for the* Terreſtrial Globe, *but alſo the Advice and directions of divers able Mathematicians, both in* England *and* Holland*. for Tables and Calculations both of the Lines and Stars for the* Cœleſtial; *upon which Globe I have placed every Star that was obſerved by* Tycho Brahe *and other Obſervers, one degree of Longitude farther in the Ecliptick than they are on any other Globes; ſo that whereas on other Globes the places of the Stars were correſpondent with their places in Heaven* 69 *Years ago, when* Tycho *obſerved them, and therefore according to his Rule want almoſt a degree of their true places in Heaven at this Time; I have ſet every Star one degree farther in the Ecliptick, and rectified them on the Globe, according to the true place they had in Heaven in the Year* 1671.

On the Terreſtrial Globe *I have inſerted all the New diſcoverias that have been made, either by our own, or Forraign Navigaters, and that both in the Eaſt, Weſt, North and South parts of the Earth. In the* Eaſt-Indies *we have in theſe latter Times many ſpacious places diſcovered, many Iſlands incerted, and generally the whole Draught of the Country rectified and amended, even to the Coaſt of* China, Iapan, Giloli, *&c. In the* South Sea *between the* Eaſt *and* Weſt-Indies *are ſcattered many Iſlands, which for the uncertain knowledge former Times had of them, are either wholly left out of other Globes, or elſe laid down ſo erroneouſly, that little of credit can be attributed unto them.* California *is found to be an Iſland, though formerly ſuppoſed to be part of the main Continent, whoſe North-Weſt ſhoar was imagined to thruſt it ſelf forth cloſe to the Coaſts of* Cathaio, *and ſo make the ſuppoſed* Straights of Anian. *The Weſtern Shoars of the* Weſt-Indies *are more accurately deſcribed than formerly, as you may, ſee if you compare my* Terreſtial Globe, *that I have lately ſet forth with the Journals of the lateſt Navigaters: And if you compare them* with other Globes you will find 5, 6, yea 7 degrees difference in Longitude in moſt Places of theſe Coaſts. Magellanica which heretofore was thought to be part of the South Continent called Terra Incognita is now alſo found to be an Iſland. All that Tract of Land called Terra Incognita I have purpoſely omitted, becauſe as yet we have no certainty whether it be Sea or Land, unleſs it be of ſome parts lately found out by the Dutch; who having a convenient Port at Batavia in Java, have from thence ſet forth Ships Southwards, where they have found ſeveral very large countries; one whereof they have called Hollandia Nova, another Zelaneir Nova, another Anthoni van Diemans Land; and divers others, ſome whereof lie near our Antipodes, as you may ſee by my Terreſtrial Globe. Again, Far to the Northwards there are ſome New Diſcoveries, even within ſix degrees of the Pole: The Drafts to the North Eaſtwards I have laid down even as they were deſcribed by the Searchers of thoſe parts for a paſſage into the Eaſt-Indies. And alſo the Diſcoveries of Baffin, Capt. James, and Capt. Fox (our own Country-men) that attempted the finding a paſſage that way into the South Sea.

I alſo told you what difference there is in ſeveral Authors about placing the firſt Meridian, which is the beginning of Longitude; that Ptolomy placed it at the Fortunate Iſlands, which Mr. Hues pag. 4. Chap. 1. in his Treatiſe of Globes proves to be the Iſlands of Cabo Verde, and not thoſe now called the Canary Iſlands; becauſe in his Time they where the fartheſt place of the Diſcovered World towards the ſetting of the Sun: Others placed it at Pico in Teneriffa; Others at Corvus and Flora; becauſe under that Meridian the Compaſs had no Variation, but did then duly reſpect the North and South; Others for the ſame Reaſon began their Longitude at St. Michaels; and others between the Iſlands of Flores and Fayal: And the Spaniards of late by reaſon of their great Negotiation in the Weſt-Indies, have begun their Longitude at Toledo there, and contrary to all others account it Weſtwards.

Therefore I ſeeing ſuch diverſity among all Nations, and as yet an Uniformity at home, choſe with our own Country-men to place my Firſt Meridian at the Iſle Gratioſa, one of the Iſles of Azores.

By the different placing of this firſt Meridian it comes to paſs, that the Longitudes of places are diverſly ſet down in different Tables; For thoſe Globes or Maps that have their firſt Meridian placed to the Eaſtwards of Gratioſa, have all places counted Eaſtwards between the firſt Meridian and the Meridian of Gratioſa in fewer degrees of Longitude: And thoſe Globes and Maps that have their firſt Meridian placed to the Weſtward, have all places counted Eaſtwards from the Meridian of Gratioſa, and their firſt Meridian in a greater number of degrees of Longitude, and that according as the Arch of Difference is.

As an Appendix to this Book, I have added a deſcription of the Ptolomaick Spheres, and have incerted ſome particular Problems of its uſe; together with Inſtructions how the whole uſe of that Sphere, may eaſily be known by this Book.

I have alſo annexed a ſmall Collection out of Dr. Hood, which declares the Reaſons why ſuch ſtrange Figures and Forms are pictured on the Cæleſtial Globe; and withal, the Poetical Stories of every Conſtellation.

I likewiſe thought good to add at the latter end of this Book, a ſmall Treatiſe, intituled The Aniqtuity, Progreſs, and Augmentation of Aſtronomy. I may without partiality give it the Encomium of a Pithy, Pleaſant, and Methodical piece: It was written by Gaſſendus, and is worthy the Peruſal of all Ingenious Lovers of the Studies.

Joſeph Moxon.

The Firſt BOOK.

Being the firſt *Rudiments* of

Aſtronomy *and* Geography.

OR, A

Deſcription of the *Lines*, *Circles*, and other Parts of the

GLOBES.

PREFACE.

THE Students of all Arts and Sciences have ever propoſed a Maxim, whereon (as on an allowed Truth) the whole Science hath dependance: And by ſo much the more demonſtrable that Maxim is, ſo much the more of Excellency the Science may claim.

This of Aſtronomy *and* Geography *comes not behind any; for herein we ſhall only admit (with the Ancients) that the Form of the viſible* World *is* Spherial. *Neither ſhall we beg our Aſſertion any further than* Ocular Appearance *will demonſtrate: Every Mans Eye being his Judge, if he be either on a* Plain Field, *or at* Sea, *where nothing can hinder a free inſpection of the* Horizon.

Upon good grounds therefore, they aſſerted the Spherical form of the Whole: And alſo concluded the Parts to be Round: I mean every intire Subſiſtence, as the Stars, Planets, *and the* Earth. *In the* Celeſtial Bodies (*as the* Stars *and* Planets) *this is alſo viſible; and therefore uncontroulable: But that the* Earth *is Round proves with* *the unskilful, matter of diſpute; they frequently objecting with S.* Auſtine *the words of the Scripture, which ſay,* He hath ſtretched forth the Corners of the Earth; *not conſidering whether thoſe Words were ſpoken as alluding to the amplitude of Gods Omnipotence, or that the* Corners *were meant* Capes *of* Land, *which indeed are ſtretched forth into the Sea. But that the* Earth *is Round is proved by divers certain and infallible Reaſons.*

As firſt, By the Navigations *of our Age, Divers able and honeſt Mariners Sailing and continuing an* Eaſterly Courſe, *have at length arrived (without turning back) to the ſame Place from whence they ſet forth: Witneſs* Magellanicus, *Sir* Francis Drake, Tho. Cavendiſh, Oliver vander Noort, W. Schouten, *&c.*

Secondly, By the length of Degrees in every Parallel; for it is found by Duly obſervation that the Degrees of every Parallel upon the Earth, *hold the ſame proportion to the Degrees of the* Equinoctial, *as the Degrees of the ſame Parallel upon an Artificical* Globe *or* Sphere *do to the Degrees of the greateſt Circle of the ſame: This Argument alone is ſufficient: Yet take one more from viſible Appearance; and that is this; the ſhadow which the* Earth *and* Water *together make in the* Eclipſe *of the* Moon *is always a part of a Circle; therefore the* Earth *and* Water, *which is the Body ſhadowing, muſt alſo be a Circular or Round Body; for if it were three ſquare, four ſquare, or any other form, then would the ſhadow which it makes in the Moon be of the ſame faſhion.*

Beſides, Of all figures the Sphere *or* Globe *is moſt Perfect, moſt Capacious, and moſt Intire of it ſelf, without either Joynts or Angles; which form we may alſo perceive the* Sun, Moon, *and* Stars *to have, and all other things that are bounded by themſelves, as Drops of* Water, *and other liquid things.*

But there is another frequent Argument againſt the Globulous *form of the* Earth; *and that is, That it ſeems impoſſible that the* Earth *ſhould be Round, and yet alſo Inhabitable in all Places: For though We that Inhabit on the top of the* Earth *go with our Heads upwards; yet thoſe that Inhabit underneath us, muſt needs go with their Heads downwards, like Flyes on a Wall or Cieling; and ſo be in danger of falling into the* Air.

For Anſwer hereunto, Firſt, You muſt underſtand that in the Center of the Earth *there is an Attractive and Drawing Power, which draws all heavy ſubſtances to it: By virtue of which Attractive Power, things thȯ looſed from the* Earth *will again incline and cling to the* Earth, *and ſo much the more forcibly, by how much the heavier they are; as a Bullet of* Lead *let fall out of the* Air, *inclines towards the* Earth *far more violently and ſwiftly than a Bullet of the ſame bigneſs of Wood or Cork.*

Secondly, You muſt underſtand that in reſpect of the whole Univerſe there is no part either Upper or Under; but all parts of the Earth *are alike incompaſt with* Heaven; *yet in reſpect of the* Earth, *it is* Heaven, *which we take for the Upper part: And therefore we are ſaid to go with our Heads upwards; becauſe our Head (of all the parts of our Body) is neareſt to* Heaven.

Now that this Attractive Power lies in the Center of the Earth *is proved by this Argument: If the Attractive Power were not in the Center, a Plumb-line let fall would not make Right Angles with the Superficies of the Earth; but would be Attracted that way the Attractive virtues lies, and ſo make unequal Angles with the Superficies: But by ſo many Experiments as have yet been made, we find that a Plumb-line continued, though never ſo Deep, yet it alters no Angles with the Superficies of the* Earth; *and therefore undoubtedly the Attractive Power lies in the very Center, and no where elſe.*

CHAP. I.

§ I. *What a* Globe *is.*

A *Globe* (according to the Mathematical Definition) is a perfect and exact round Body, contained under one Surface.

Of this Form (as hath been proved) conſiſts the *Heavens* and the *Earth*: And therefore the Ancients with much Pains, Study and Induſtry, endeavouring to imitate as well the imaginary as the real appearances of them both, have Invented two *Globes*, the one to repreſent the *Heavens*, with all the *Conſtellations*, *fixed Stars*, *Circles* and *Lines* proper thereunto, which *Globe* is called the *Cœleſtial Globe*; and the other with all the *Sea Coaſt*, *Havens*, *Rivers*, *Lakes*, *Cities*, *Towns*, *Hills*, *Capes*, *Seas*, *Sands*, &c. as alſo the *Rumbs*, *Meridians*, *Parallels*, and other *Lines* that ſerve to facilitate the Demonſtration of all manner of Queſtions to be performed upon the ſame: And this *Globe* is called ths *Terreſtrial Globe*.

§ II. *Of the two* Poles.

Every *Globe* hath two *Poles*, the one *North*, and the other *South*. The *North Pole* is the *North* point of the *Globe*: The *South Pole* is the *South* point.

§ III. *Of the* Axis.

From the Center of the *Globe* both ways proceeds a Line through both the *Poles*, and continues itſelf infinitely; which is called the *Axis of the World*; and is repreſented by the two wyers in the *Ploes* of the *Globe*: Upon theſe two wyers the *Globe* is turned round, even as the *Heavens* is imagined to move upon the *Axis* of the *World*.

§ IV. *Of the* Braſen Meridian.

Every *Globe* is Hung by the *Axis* at both the *Poles* in a *Braſen Meridian*, which is divided into 360 *degrees*; (or which is all one into 4 Nineties: The firſt beginning at the *North Pole*, is continued from the left hand towards the right, till the termination of 90 *degrees*, and is marked with 10, 20, 30, 40, &c. to 90. from whence the *degrees* are numbred with 80, 70, 60, &c. to 0. which is in the *South Pole*: From whence again the *degrees* are numbred with 80, 70, 60, &c. to 0. and laſtly from 0 the *degrees* are numbred with 10, 20, 30, to 90. which is again in the *North Pole*.

This *Braſen Meridian* is of great uſe; for by the help of it you may find the *Latitude* of all Places, the *Right Aſcention* and *Declination* of all the *Stars*, &c. and Rectifie the *Globe* to any Latitude.

§ V. *Of the* Horizon.

The *Horizon* is a broad Wooden Circle, encompaſſing the *Globe*; having two Notches in it, the one in the *North*, the other in the *South* point: The Notches are made juſt fit to contain the *Braſen Meridian* that the *Globe* is Hung in: In the Bottom or under Plain of the *Horizon* there ſtands up a Prop, or (as it is called) a *Bed*, in which there is alſo a Notch, into which Notch the *Braſen Meridian* is alſo let, ſo low as that both it and the *Globe* may be divided into two equal halfs by the upper Plain of the Wooden *Horizon*. Theſe Notches are as gages to keep the *Globe* from inclining more to the one ſide of the Wooden *Horizon* than the other.

Upon the upper Plain of the *Horizon*, is ſeveral *Circles* delineated: As firſt, the Inner *Circle*, which is a *Circle* divided into twelve equal parts, *viz.* into twelve *Signs*, every *Sign* having its name perfixed to it; as to the *Sign* of ♈ is the word *Aries*; to ♉ the word *Taurus*, &c. every *Sign* again is divided into 30 equal parts which are called *Degrees*, and every tenth *Degree* is marked with 10, 20, or 30.

Next to the *Circle of Signs* is a *Kalender* or *Almanack*, according to the *Old Stile* uſed by us here in *England*, each *Month* being noted with its proper name; as *January*, *February*, *March*, *&c.* and every *Day* diſtinguiſhed with Arithmetical Figures, at 1, 2, 3, 4, &c. to the end of the *Month*.

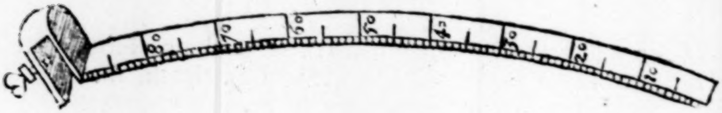
The other *Kalender* is a *Kalender* of the *New Stile*; which is in manner all one with the *Old*; only in this *Kalender* the *Month* begins ten days ſooner than they do in the other: And to this *Kalender* (becauſe it was inſtituted by the Church of *Rome*) there is annexed the *Feſtival Days* celebrated by the *Romiſh* Church.

The two other *Circles* are the *Circles* of the *VVinds*; the innermoſt having their *Greek* and *Latine* Names, which by them were but twelve; and the outermoſt having the *Engliſh* Names, which for more preciſeneſs are two and thirty.

The uſe of the upper plain of the *Horizon* is to diſtinguiſh the *Day* from *Night*; the *Riſing* and *Setting* of the *Sun*, *Moon*, or *Stars*, &c. and for the finding the *Azimuth*, and *Amplitude*, &c.

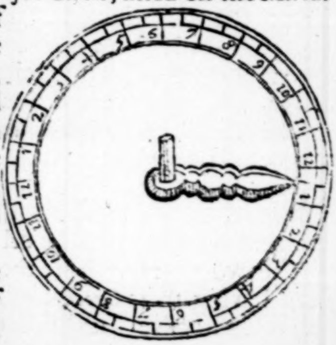
§ VI. *Of the* Quadrant *of* Altitude.

The *Quadrant of Altitude* is a thin Braſs Plate, divided into 90 Degrees, and marked upwards with 10, 20, 30, 40, *&c.* to 90. It is revitted to a Braſs Nut, which is fitted to the *Meridian*, and hath a Screw in it, to ſcrew upon any Degree of the *Meridian*. When it is uſed it is moſt commonly Screwed to the *Zenith*. Its uſe is for meaſuring the *Altitudes*, finding *Amplitudes*, and *Azimuths*, and deſcribing *Almicantaraths*. It would ſometimes ſtand you in good ſtead if the Plate were longer by the breadth of the *Horizon* than 90 Degrees; for then that length being turned back will ſerve you inſtead of an *Index*: When the *Nut* is ſcrewed to the *Zenith*, to cut either the Degrees or Days of either *Stile* or the *Points of the Compaſs* in any of thoſe *Circles* concentrical to the innermoſt edge of the *Horizon*: which the Eye cannot ſo well judge at.



§ VII. *Of the* Hour Circle, *and its* Index.

The *Hour Circle* is a ſmall *Braſen Circle*, fitted on the *Meridian*, whoſe Center is the *Pole* of the World: It is divided into the 24 Hours of the Day and Night, and each Hour is again divided into Halfs and Quarters, which in a Revolution of the *Globe* are all pointed at with an *Index*, which to that purpoſe is fitted on the *Axis* of the *Globe*.



The uſe of the Hour Circle is for the ſhewing the Time of the ſeveral Mutations and Configurations of *Celeſtial* Appearances.

§ VIII.

§ VIII. *Of the* Nautical Compaſs, *or* Box *and* Needle.

Juſt under the *North* point of the *Horizon*, upon the undermoſt Plain is ſometimes fixed a *Nautical Compaſs*, whoſe *North* and *South* line muſt be Parallel to the *North* and *South* line of the *Horizon*. The Uſe of it is for ſetting the Angles of the *Globe* correſpondent to the Angles of the *World*.

§ IX. *Of the* Semi-Circle *of* Poſition.

Thoſe that are *Aſtrologically* addicted, will want a Circle of Poſition to their Globes.

This is a *Semi-Circle* made of Braſs and divided into 180 degrees, numbred from the Equinoctial on either ſide with 10, 20, 30, &c. to 90. At the two ends there is an *Axis*, which is fitted into the two Holes of two ſmall Studs, fixed in the *North* and *South* line of the upper Plain of the *Horizon*: Upon this *Axis* it is moved up and down, according to the intent of your Operation.

The Uſe of this *Circle of Poſition* is, for the finding the *twelve Aſtrological Houſes of Heaven*; and alſo for finding the *Circle of Poſition* of any *Star* or Point in *Heaven*.

Thus much may ſerve for the lineaments circumjacent to the body of the Globe. The next diſcourſe ſhall be

CHAP. II.

Of the Circles, Lines, *&c. deſcribed upon the* Superficies *of the* Globe; *beginning with the* Terreſtrial Globe; *and*

§ I. *Of the* Equator.

THe *Equator* is a great *Circle*, encompaſſing the very middle of the *Globe* between the two *Poles* thereof, and divides it into two equal parts, the one the *North* part, and the other the *South* part. It is (as all Great Circles are) divided into 360 equal parts which are called *Degrees*. Upon this *Circle* the *Longitude* is number'd, from *Weſt* to *Eaſt*, and from this *Circle* both ways, *viz.* *North* and *South* the *Latitude* is reckoned. It is called the *Equator*, becauſe when the *Sun* comes to the Line (which is twice in one Year, to wit, on the Tenth of *March*, and the Thirteenth of *September*) the *Days* and *Nights* are Equated, and both of one Length.

§ II. *Of the* Meridians.

There are infinite of *Meridians*, for all Places lying *Eaſt* or *Weſt* from one another have ſeveral *Meridians*; but the *Meridians* delineated upon the *Terreſtial Globe* are in number 36, ſo that between two *Meridians* is contained ten *Degrees* of the *Equator*. From the *Firſt* of theſe Meridians (which is divided into twice 90 Degrees) accounted from the *Equator* towards either *Pole*, is the beginning of *Longitude*, which upon our *Engliſh Globes* is at the Iſle *Gratioſa*, one of the Iſles of the *Azores*, and numbred in the *Equator Eaſtwards*, with 10, 20, 30. &c. to 360. round about the *Globe*, till it end where it began.

They are called *Meridians*, becauſe they divide the *Day* into two equal parts: For when the *Sun* comes to the *Meridian* of any Place, it is then *Mid-day*, or *Full-Noon*.

§ III. *Of the* Parallels.

As the *Meridians* are infinite, ſo are the *Parallels*; and as the *Meridian* lines delineated upon the *Globe* are drawn through no more than every Tenth *Degree* of the *Equator*, ſo are the *Parallels* alſo delineated but upon every tenth *Degree* of the *Meridian*; leſt the *Globe* ſhould be too much filled with Superfluity of *Lines*, which might obſcure the ſmall Names of Places. The *Parallel Circles* run *Eaſt* and *Weſt* round about the Globe, even as the *Equator*, only the *Equator* is a Great Circle, and theſe are every one leſs than other; diminiſhing gradually till they end in the *Pole*. The *Parallels* are numbred upon the *Meridian* with 10, 20, 30, &c. to 90. beginning in the *Equator*, and ending in the *Pole*.

They are called *Parallels*; becauſe they are *Parallel* to the *Equator*.

§ IV. *Of the* Eclipticks, Tropicks, *and* Polar Circles.

Theſe Circles though they are delineated upon the *Terreſtrial Globe*, yet they are moſt proper to the *Celeſtial*; and therefore when I come to the *Celeſtial Globe*, I ſhall define them unto you.

§ V. *Of the* Rhumbs.

The *Rhumbs* are neither Circles nor ſtreight Lines, but *Heliſpherical* or *Spiral lines*: they proceed from the Point where we ſtand, and wind about the *Globe* till they come to the *Pole*; where at laſt they loſe themſelves. They repreſent the 32 *VVinds* of the *Compaſs*.

Their Uſe is to ſhew the *Bearing* of any two places one from another: That is to ſay, upon what *Point of the Compaſs* any *Shoar or Land* lies from another.

There are many of them deſcribed upon the *Globe*, for the better directing the Eye from one *Shoar* to the other, when you ſeek after the *Bearing* of any two *Lands*. Some of them (where there is room for it) having the figure of the *Nautical Card* drawn about the Center or common interſection, and have (as all other *Cards* have) for the diſtinction of the *North Pont*, a *Flowerdeluce* pictured thereon.

They were firſt called *Rhumbs* by the *Portugals*; and the name ſince Uſed by *Latine* Authors, and continued by all Writers that have occaſion to ſpeak of them.

§ VI. *Of the* Lands, Seas, Iſlands, *&c. Deſcribed upon the* Terreſtrial Globe.

The *Land* deſcribed upon the *Globe* is bounded with an irregular Line, which runs turning and winding into *Creeks* and *Angles*, even as the *Shoar* which it repreſents (doth.) For the better diſtinction of *Lands &c.* this line is colour'd cloſe by one ſide thereof with divers Colours, as with Red, Yellow, Green, *&c.* theſe Colours diſtinguiſh one part of the *Continent* from the other; and alſo one *Iſland* from another. That ſide of the line which incompaſſes the Colours, is the bounds of the *Land*; the other ſide of the line which is left bare without Colours, is the limits of the *Water*.

The *Land* is either *Continents*, or *Iſlands*.

A *Continent* is a great quantity of *Land*, not interlaced or ſeparated by the *Sea*, in which many *Kingdoms* and *Principalities* are contained; as *Europe*, *Aſia*, *Africa*, *America*.

An *Iſland* is a part of the *Earth*, environed round with *VVaters*, as *Britain*, *Java S. Laurence Iſle*, *Bermudas*, &c.

Theſe again are ſubdivided into *Preninſula*, *Iſthmus*, *Promontorium*.

A *Peninſula* is almoſt an *Iſland*; that is, a Track of *Land*, which being almoſt encompaſſed round with *VVater*, is joyned to the firm *Land*, by ſome little *Iſtmus*,; as *Malacca* in the *Eaſt-Indies*, &c.

An *Iſtmus* is a little narrow Neck of *Land*, which joyneth any *Peninſula* to the *Continent*; as the *Straits* of *Dariene* in *Peru*, and *Corinth* in *Greece*.

A *Promontory* is ſome High *Mountain*, which ſhooteth it ſelf into the *Sea*, the utmoſt End or Point of which is called a *Cape*; as that great *Cape of good Hope*, and *Cape Verde* in *Africa*.

The *VVater* is either *Ocean*, *Sea*, *Straits*, *Creeks*, *Lakes*, or *Rivers*.

The *Ocean* is that general collection of all *VVaters*, which invironeth the whole *Earth* on every ſide.

The *Sea* is part of the *Ocean*; to which we cannot come but through ſome *Strait*, as *Mare Mediterraneum*, *Mare Balticum*, and the like.

Theſe take their names either from the adjacent Places, as the *Brittiſh Ocean*, the *Atlantick Sea*, &c. or from the firſt Diſcoverer; as *Mare Magellanicum*; *Davis* and *Forbiſhers Straits*, &c. Or from ſome remarkable accident, as *Mare Rubrum*, from the Red colour of the *Sands*; *Mare Ægeum*, *Pontus Euxinus*, and the like.

A *Strait* is a part of the *Ocean* reſtrained within narrow bounds, and opening a way to the *Sea*; as the *Straits* of *Gibraltar*, *Helleſpont*, &c.

A *Creek*, is a crooked *Shoar*, thruſting out (as it were) two arms to imbrace the *Sea*, as *Sinus Adriaticus*, *Sinus Perſicus*, &c.

A *River* is a ſmall Branch of the *Sea*, flowing into the *Land*; as *Thames*, *Tiber*, *Rhine*, *Nilus*, &c.

Now that theſe *Lands*, *Iſlands*, *Towns*, *Seas*, *Rivers*, &c. may at the firſt ſearch be found upon the *Globe*, all *Geographers* have placed them thereon according to *Longitude* and *Latitude*.

§ VIII. Longitude.

The *Longitude* is an Arch of the *Equator*, comprehended between the *Firſt Meridian* and the *Meridian* of the *Place* you inquire after. It is numbered on the *Equator* from the *VVeſt* to the *Eaſtwards* with 10, 20, 30, to 360 *Degrees*, till it end where it began.

§ VIII.

§ VIII. Latitude.

The *Latitude* is an Arch of the *Meridian* comprehended between the *Equator* and the *Place* enquired after. It is numbred on the *Meridian* from the *Equator* both ways, *viz.* *North* and *South*, till it come to the *Poles*, or 90 Degrees.

Thus much may ſerve for the deſcription of the *Terreſtrial Globe*: I therefore come to treat of the *Cæleſtial*.

CHAP. III.

Of the Cœleſtial Globe, *or the Eighth* Sphere, *repreſented by the* Cœleſtial Globe: *Its Motion, and of the* Circles, Lines, Images, Stars, *&c. deſcribed thereon.*

§ 1. *Of the eighth* Sphere.

THe Eighth *Sphere* which is the *Starry Heaven*, is repreſented by the *Cæleſtial Globe*, becauſe upon the Convexity of it, all the *Stars* and viſible appearances, are placed according to the order that they are ſituated in the Concavity of the Eighth *Sphere*. It is called the *Eighth Sphere*, Becauſe between it and us are contained ſeven other *Heavens* or *Spheres*; as 1. the *Moon*; 2. *Mercury*, 3. *Venus*, 4. *the Sun*, 5. *Mars*; 6. *Jupiter*, 7. *Saturn*, and eighthly the *Starry Heaven*. The Ancients have made the Syſteme of the *World* to conſiſt of two other *Spheres*, called the *Chryſtalline Heaven*, and the *Primum Mobili*: Or *firſt Mover*: As in the following Ficture is preſented.

A Figure wherein may be ſeen the Compoſition of the whole Frame of the World.

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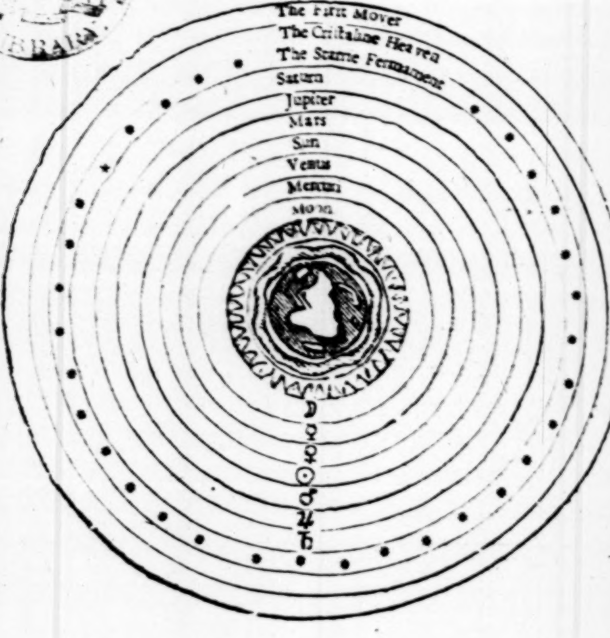
The First Mover
The Criſtaline Heaven
The Starrie Firmament
Saturn
Jupiter
Mars
Sun
Venus
Mercury
Moon
☽
☿
♀
☉
♂
♃
♄

§ II. *Of the Motion of the* Eighth Sphear.

There hath been attributed to the *Eighth Sphear* a twofold Motion, the one called its *Diurnal Motion*, which is made from *Eaſt* to *Weſt*, upon the *Poles* and *Axis*, of the *World*, and the other called its *Second Motion*; which is made from *Weſt* to *Eaſt* upon the *Poles* and *Axis* of the *Ecliptick*.

The *Diurnal Motion* is cauſed by the violent Motion of the *Primum*

Primum Mobile; for in 24 *Hours* it carries along with it, not only the *Eighth Heaven* or Orb of *Fixed Stars*, but the Orbs of the *Sun*, the *Moon*, and all the reſt of the *Planets*. It is called the *Diurnal Motion*, becauſe it is finiſhed in one Day.

The *Second Motion* is unproperly attributed to the *Eighth Sphear*; it being indeed the Motion of the *Equinoctial*, though Authors ſometimes careleſly mention the one inſtead of the other. Therefore in the next *Section*, where I treat of the *Equinoctial*, I ſhall at large explain unto you the nature of this miſcalled *Second Motion*.

§ III. *Of the* Equinoctial.

The *Equinoctial* on the *Cæleſtial Globe* is the ſame line formerly called the *Equator* upon the *Terreſtrial*; only with this difference, that the *Equator* remains fixt upon the *Terreſtrial Globe*, but the *Equinoctial* upon the *Cæleſtial Globe* is moveable; (or at leaſt muſt be imagined to move) contrary to the *Diurnal Motion* from *Weſt* to *Eaſt*, upon the *Poles* of the *Ecliptick*: I ſay imagined to move, becauſe in the *Heavens* it, with its whole *Orb*, *viz*. the *Eighth Sphear*, doth really move, though on a material *Globe* it would be inconvenient to make a moveable *Equinoctial*, and therefore it hath one fixed: Which for this and the next Age will ſufficiently ſerve, without much deviation from the Truth it ſelf.

Now that the difference between the *Equator* upon the *Terreſtrial Globe*, and the *Equinoctial* upon the *Cæleſtial*, may be proved; and the Motiyn of the *Equinoctial* be the better underſtood; I ſhall only bring this Example;

All places that were formerly under the *Equator*, do and will keep the ſame *Longitude*, and remain ſtill under the *Equator*: As may be proved by comparing the Ancient and Modern *Geographers* together: But thoſe *Stars* that were formerly under the *Equinoctial*, do not keep the ſame *Longitude*, nor remain under the *Equinoctial*: becauſe the *Equinoctial* (as aforeſaid) hath a Motion from *Weſt* to *Eaſt*, upon the *Poles* of the *Ecliptick*. But the *Stars* being fixed in their own *Sphear*, like knots in Wood, therefore move not, are by the Preceſſion of the *Equinox* left behind the *Equinoctial Colure*, and ſo are cauſed to alter their *Longitude*; as by comparing the Obſervations of ancient and Modern *Aſtronomers* together, it will appear: for about 346

Years before Chriſt, the firſt *Star* in the *Rams horn* was by the *Egyptian* and *Grecian Aſtronomers* Obſerved to be in the *Equinoctial Colure*: And 59 *Years* ago, when *Tycho* Obſerved, it was found to be in 27 *Degrees*, 37 *Minutes* of ♈. So that in about 2000 *Years* it is moved forwards 28 *Degrees*, and will according to *Tycho*'s opinion, finiſh its Revolution in 25412 *Years*: According to which Motion, I have Calculated this following Table, for finding the *Degrees* and *Minutes* of the *Equinoctial* Motion, anſwerable to any number of *Years* within the ſaid Revolution.

ye.	deg.	m.	years.	deg.	m.
1	0	$0\frac{3}{4}$	100	1	25
2	0	$1\frac{1}{2}$	200	2	50
3	0	$2\frac{1}{2}$	300	4	15
4	0	$3\frac{1}{3}$	400	5	40
5	0	$4\frac{1}{4}$	500	7	5
6	0	5	1000	14	10
7	0	$5\frac{3}{4}$	2000	28	20
8	0	$6\frac{1}{2}$	3000	42	30
9	0	$7\frac{1}{4}$	4000	56	40
10	0	$8\frac{1}{2}$	5000	70	50
20	0	17	10000	141	40
40	0	34	20000	283	20
60	0	51	25000	354	10
80	1	8	25412	360	

This Table may be of Uſe for finding the *Equinoctial* poſition of any *Star*, for any *Year* either paſt, preſent, or to come. Its uſe is very eaſie: For if you deſire to know the Motion of the *Equinox* for any number of *Years*, you need but ſeek your number in the Column of *Years*, and againſt it you have the *Degrees* and *Minutes* of the *Equinoctial Motion*.

But though the *Stars* have this Motion one way, *viz.* in *Longuitude*, yet do they not at all alter their *Latitude*; Becauſe the Motion of the *Equinoctial* is made upon the *Poles* of the *Ecliptick*.

§ IV.

§ IV. *Of the* Ecliptick.

The *Ecliptick* is a Great Circle, lying oblique or aſlope from the *Equinoctial*, making an Angle of 23½ Degrees with it: It cuts the *Equinoctial* into two equal parts, and is cut by the *Equinoctial* in two oppoſite points, *viz.* in ♈, and ♎. It divides the *Globe* into two equal parts, called *Hemiſphears*; the one the *Northern*, and the other the *Southern Hemiſphear*. It is divided into 12 equal Parts, which are called the twelve *Signs*; every part being noted with the Character of the *Sign* belonging unto it, as unto *Aries*, ♈, to *Tauris*, ♉, to *Gemini*, ♊, and ſo of the reſt. From every one of theſe 12 diviſions proceed both ways, *viz. North*, and *South*, *Circles* of *Longitude*, into the *Poles* of the *Ecliptick*. Each of theſe 12 *Signs* is divided into 30 equal parts, which are called *Degrees*; and are numbred upon every tenth *Degree* with 10, 20, to 30, and upon my new *Cæleſtial Globe* for more preciſeneſs, every *Degree* is again divided into halfs.

“ It is called the Ecliptick as being derived from the Greek
“ word *Eklepſin*, which ſignifies to want Light: Becauſe in
“ and about it happen all the defects and *Eclipſes* both of the
“ *Sun* and the *Moon*.

“ It is alſo called *the way of the Sun*, becauſe the *Sun* goes al-
‘ ways under it, paſſing through it in all his *Annual* Courſe.

§ V. *Of the* Poles *of the* Ecliptick.

There are two *Poles* of the *Ecliptick*, the one the *North Pole*, the other the *South Pole*; and are called *North* or *South* according to their poſition next the *North* or *South Pole* of the World. Each is diſtant from its correſpondent *Pole* of the *World* 23 *Degrees*, 30 *Minutes*.

As on the *Terreſtrial Globe*, all the *Meridians* deſcribed thereon meet in the *Pole* of the *World*, ſo on the *Cæleſtial* all the *Circles* of *Longitude* drawn through the *Twelve Signs* meet in the *Poles* of the *Ecliptick*.

§ VI. *Of the* Axis *of the* Eclipticк.

Through the *Poles* of the *Ecliptick* is imagined to paſs a ſtreight line through the Center of the Plain of the *Ecliptick*: which is called *the Axis of the Ecliptick*, upon which the *Second Motion* of the *Ecliptick* is performed, even as the *Diurnal Motion* is performed upon the *Axis* of the *World*.

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§ VII. *Of the* Colures, *and* Cardinal Points.

There are two Great Circles cutting one another at right Angels in the *Poles* of the *VVorld*, which are called the *Colures*. Each *Colure* receives an additional name from the point in the *Ecliptick* that it cuts; as the one paſſes from *Pole* to *Pole* through the beginning of ♈ and ♎, which being two *Equinoctial Signs*, names therefore that *Colure* the *Equinoctial Colure*: The other paſſes through the beginning of ♋ and ♑, which are *Solſtitial Signs*, and therefore names that the *Solſtitial Colure*.

Theſe *Colures* by interſecting one another, divide themſelves into four Semi-circles; and theſe Semi-circles divide the *Ecliptick* into four equal parts, viz. ♈, ♋, ♎, and ♑.

The point of the *Ecliptick* that theſe interſections paſs through, are called the four *Cardinal Points*; and are of great uſe in *Aſtronomy*: for according to the *Suns* approach to any of them, the Seaſon of the Year is altered into *Spring*, *Summer*, *Autumn*, *VVinter*: As ſhall be ſhewed hereafter.

§ VIII. *Of the* Tropicks.

There are two ſmaller Circles Parallel to the *Equinoctial*, which are called the *Tropicks*, the one called the *Tropick* of *Cancer*, the other the *Tropick* of *Capricorn*: They are diſtant from the *Equinoctial* 23 *Degrees* 30 *Minutes*; and therefore are the bounds of the *Ecliptick*. They receive their names from the *Cœleſtial Sign* that they are joyned unto; as the one the *Tropick* of *Cancer*, becauſe it touches the *Sign* of *Cancer*; the other the *Tropick* of *Capricon*, becauſe it touches the *Sign* of *Capricorn*.

§ IX. *Of the Circles* Arctick *and* Amarctick.

About the *Poles* of the *World* are deſcribed two ſmall Parallel *Circles*; the one called the *Arctick*, the other the *Antarctick*. That in the *North* is called the *Arctick Circle*, that in the *South* the *Antarctick Circle*.

They have the ſame diſtance from the *Poles* of the *World* that the *Tropicks* have from the *Equinoctial Circle* (*viz*. 23 *Degrees* 30 *Minutes*) and that the *Ecliptick* hath from the *Poles* of the *World*; and therefore run through the *Poles* of the *Ecliptick*.

§ X. *Of the* Images *called* Conſtellations, *drawn upon the* Celeſtial Globe.

Here I think fit to be beholden to Dr. H*ood*, for the pains he hath taken in his Comment or the *Images* and *Conſtellations*. He ſaith, The *Stars* are brought into *Conſtellations* for inſtructions ſake: things cannot be taught without Names; to give a Name to every *Star* had been troubleſome to the Maſter, and for the Scholar; for the Maſter to deviſe, and for the Scholar to remember: and therefore the *Aſtronomers* have reduced many *Stars* into one *Conſtellation*, that thereby they tell the better where to ſeek them; and being ſought, how to expreſs them.

All the Co*nſtellations* formerly notified by the Ancients were in number 48, twelve whereof we call *the twelve* S*igns* of the *Zodiack*, *viz*. 1 *Aries*, ♈, 2 *Taurus*, ♉, 3 *Gemini*, ♊, 4 *Cancer*, ♋, 5 *Leo*, ♌, 6 *Virgo*, ♍, 7 *Libra*, ♎, 8 Scorp*io*, ♏, 9 S*agittarius*, ♐, 10 C*apricorn*, ♑, 11 *Aquarius*, ♒, 12 *Piſces*, ♓. One and twenty more are placed in the *North* Hem*iſphere*, and are called 1 *Urſa minor*, 2 *Urſa major*, 3 *Draco*, 4 C*epheus*, 5 *Bootes*, 6 C*orona* S*eptentri*, 7 H*ercules*, 8 *Lyra*, 9 C*ygnus*, 10 C*aſſiopea*, 11 *Perſeus*, 12 *Auriga*, 13 S*erpentarius*, 14 *Serpens* O*phiuchi*, 15 S*agitta*, 16 *Aquila*, 17 *Delphinus*, 18 *Equiculus*, 19 *Pegaſus*, 20 *Andromeda*, 21 *Triangulum*. The other 15 are Situate in the S*outh* Hem*iſphere*, and called 1 C*etus*, 2 *Orion*, 3 *Eridanus*, 4 *Lepus*, 5 C*anis major*, 6 C*anicula*, 7 *Argo Navis*, 8 H*ydra*, 9 C*rater*, 10 C*orvus*, 11 C*entaurus*, 12 *Lupus*, 13 *Ara*, 14 C*orona Auſtrina*, 15 *Piſces Auſtrina*. Beſides, there are two other C*onſtellations* in the *North* H*emiſphere*, *viz*. *Antinous*, and *Coma Berenices:* which becauſe they were not ſpecified by the Ancients, are here inſerted apart.

Now the *Aſtronomers* did bring them into theſe Figures, and not into other, being moved thereto by theſe three Reaſons: Firſt, theſe Figures expreſs ſome properties of the *Stars* that are in them; as thoſe of the *Ram* to be Hot and Dry; *Andromeda* chained betokeneth Impriſonment: the Head of *Meduſa* cut off, ſignifies the loſs of that part: *Orion* with his terrible and threatning geſture, importeth Tempeſt and terrible effects: The *Serpent*, the *Scorpion*, and the *Dragon* ſignify Poyſon: The *Bull*, inſinuateth a Melancholly paſſion: The *Bear* inferreth Cruelty, *&c.* Secondly, the *Stars* (if not preciſely, yet after a ſort) do repreſent ſuch a Figure, and therefore that Figure was aſſigned them: as for Example, the *Crown*, both *North* and *South*; the *Scorpion* and the *Triangle*, repreſent the Figures which they have. The third Cauſe was, the continuance of the Memory of ſome notable Men, who either in regard of their ſingular pains taken in *Aſtronomy*, or in regard of ſome other notable deed, had well deſerved of Mankind.

The firſt Author of every particular *Conſtellation* is uncertain; yet are they of great Antiquity; we receive them from *Ptolomy*, and he followed the *Platonicks*; ſo that their Antiquity is great. Moreover, we may perceive them to be Ancient by the *Scriptures*, and by the *Poets*. In the 38. *Chapter* of *Job* there is mention made of the *Pleiades*, *Orion*, and *Arcturus*, and *Mazzaroth*, which ſome interpret the 12 *Signs: Job* lived in the Time of *Abraham*, as *Syderocrates* maketh mention in his Book *de Commenſurandis locorum diſtantiis.*

Now beſides all this, Touching the reaſon of the invention of theſe *Conſtellations* the *Poets* had this purpoſe, *viz.* to make Men fall in love with *Aſtronomy*. And to that intent have to every *Conſtellation* invented ſtrange conceited *Stories*; (as you may read at the latter end of this Book) therein imitating *Demoſthenes*, who when he could not get the People of *Athens* to hear him in a matter of great moment, and profitable for the Commonwealth, he began to tell them a Tale of a Fellow that ſold an *Aſs*; by which Tale, he ſo brought on the *Athenians*, that they were both willing to hear his whole Oration, and to put in Practice what he exhorted them to. The like intent had the *Poets* inventing of theſe *Stories:* They ſaw that *Aſtronomy*

being

ing for commodity ſingular in the life of Man, was almoſt of all Men utterly neglected: Hereupon they began to ſet forth that Art under *Fictions*; that thereby, ſuch as could not be perſwaded by Commodity, might by the pleaſure be induced to take a view of theſe Matters: and thereby at length fall in love with them. For commonly you ſhall note this, that he that is ready to Read the *Stories*, cannot content himſelf therewith, but deſireth alſo to know the *Conſtellation*, or at leaſtwiſe ſome principal *Star* therein.

There are in *Heaven* yet twelve *Conſtellations* more, poſited about the *South Pole*, which were added by *Frederico Houtmanno*, inhabiting on the Iſland *Sumatra*; who being accommodated with the Inſtruments of immortal *Tycho*, hath obſerved the *Longitude* and *Latitude* of thoſe *Stars*, reduced them into *Conſtellations*, and named them as follows, 1 The *Crane*, 2 The *Phenix*, 3 The *Indian*, 4 The *Peacock*, 5 The *Bird of Paradiſe*, 6 The *Fly*, 7 The *Camelion*, 8 The *South Triangle*, 9 The *Flying Fiſh*, 10 *Dorado*, 11 The *Indian Fowl*, 12 The *Southern Serpent*.

§ XI. *Of the number of the* Stars.

Although in *Heaven* there be a very great number of viſible *Stars*, which for their multitude ſeem innumerable; yet no wiſe Man will from thence infer that they are impoſſible to be counted: for there is no *Star* in *Heaven* that may be ſeen, but its *Longitude* and *Latitude* may with meet Inſtruments for that purpoſe be exactly found; and being once found, it may have a Name allotted it, which with its *Longitude* and *Latitude* may be Catalogized either for the Memory of the Obſerver, or the knowledge of Poſterity. Now therefore if any one *Star* may be Obſerved, they may all be Obſerved; and then may they all have Names given them; which though to the ignorant it ſeem uncredible, yet to the Sons of God (as *Joſephus* calls *Aſtronomers*) who herein participate of their Father's knowledge, it is eaſie to *number the Stars, and call them all by their Names*, Pſal. 97.4.

But though all the *Stars* in *Heaven* may be numbred and named, yet hath not *Tycho*, or the Ancient *Aſtronomers*, thought fit to take notice of more than 1241 of the chiefeſt that are viſible of our *Horizon*, they being ſufficient for any purpoſe that we ſhall have occaſion to apply them unto. You of late

the

the induſtry of *Fred. Houtman* aforeſaid, hath added to the Catalogue 136 *Stars*, with their *Longitude*, *Latitude*, and *Magnitude*, and given Names unto them: which upon my New *Globes* I have alſo aſcerted, as may be ſeen about the *South Pole* thereof. So that with theſe 1241 Obſerved by *Tycho* and the Ancients, and theſe 136, the whole number of the Catalogue is 1377.

Some other *Stars* of late have been alſo obſerved by *Baierus*, among the ſeveral *Conſtellations* aforeſaid; but not of any conſiderable *Magnitude*: and therefore I think fit to paſs them by, and come to their Situation in *Heaven*, according to *Longitude* and *Latitude*.

§ XII. *Of the Situation of the* Stars.

Longitude of the Stars.

The *Stars* are Situate in *Heaven* according to their *Longitude* and *Latitude*. As the *Longitude* of any Place on the *Terreſtrial Globe* is an Arch of the *Equator* comprehended between the firſt *Meridian* and the Place; ſo the *Longitude* of any *Star* on the *Celeſtial Globe* is an Arch of the *Ecliptick* contained between the firſt point of *Aries* and the *Star* inquired after. But yet becauſe the *Ecliptick* is divided into 12 *Signs*, the *Longitude* of a *Star* is therefore (in the moſt cuſtomary Account) an Arch of the *Ecliptick* comprehended between the Semi-circle of *Longitude*, paſſing through the beginning of the *Sign* the *Star* is in, and the Semi-circle of *Longitude* paſſing through the Center of the *Star*.

Latitude of the Stars.

The *Latitude* of a *Star* is either *North* or *South*: *North*, if on the *North* ſide of the *Ecliptick*; *South* if on the *South* ſide of the *Ecliptick*. As the *Latitude* of any Place on the *Terreſtrial Globe* is an Arch of the *Meridian* contained between the *Equator* and the *Parallel* of the Place, ſo is the *Latitude* of any *Star* on the *Celeſtial Globe* an Arch of a *Semi-circle* of *Longitude*, comprehended between the *Ecliptick* and the *Star* inquired after.

§ XIII. *Of the* Magnitudes *of the* Stars.

For the better diſtinction of the ſeveral ſizes of *Stars*, they are divided into ſix ſeveral *Magnitudes*. The biggeſt and brighteſt *Stars* are called *Stars of the firſt Magnitude*: Thoſe one ſize inferiour in Light and Bigneſs are called *Stars of the Second Magnitude*; Thoſe again one ſize inferiour to the *Stars* of the *Second Magnitude*, are called *Stars of the Third Magnitude*, and ſo the *Stars* gradually decreaſe unto the *Sixth Magnitude*, which is the ſmall, ſome few Obſcure *Stars* only excepted, which for their minority and dimneſs are called *Nebula*. Theſe ſeveral *Magnitudes* of the *Stars* are expreſſed on the *Globe* in ſeveral ſhapes: as may be ſeen in a ſmall Table placed on the *Globe* for that purpoſe.

The Meaſures of the ſeveral Stars.

Now for your further ſatisfaction and delight, I have inſerted a Collection of Dr. *Hood*'s, wherein is expreſſed the Meaſure of every *Magnitude*, and the Proportion it hath, firſt, to the *Diameter*, and ſecondly, to the *Body* of the *Earth*.

The greatneſs of any thing (ſaith he) cannot be better expreſſed than by comparing it to ſome common Meaſure, whoſe quantity is known: the Common Meaſure whereby *Aſtronomers* expreſs the greateſt of the *Stars*, is the *Earth*.

Sometimes they compare them with the Diameter of the *Earth*, ſometimes with the *Globe* thereof: The Diameter, according to their account, which allow but 60 *Miles* to a Degree, containeth 6822 $\frac{8}{11}$ *Miles*; and the whole Solidity of the *Globe* contains 165, 042, 481, 238 *Miles* and $\frac{78}{157}$. According to *Ptolomy*, who allotteth to every Degree 62 $\frac{1}{2}$ *Miles*: The Diameter containeth 7159 *Miles* $\frac{1}{11}$, and the whole Solidity of the *Globe* hath 192, 197, 184, 917 $\frac{473}{1331}$ *Miles*.

The proportion of the Diameters of the fixed Stars, *compared with the Diameter of the* Earth.

The Diameter of a *Fixed* Star of the *Firſt Magnitude* compared with the Diameter of the *Earth* hath ſuch Proportion to it as 19 hath to 4: therefore it containeth the Diameter of the *Earth* 4 times and $\frac{3}{4}$.

The Diameter of a *Star* of the *Second Magnitude* is unto the Diameter of the *Earth* as 269 is to 60: therefore it containeth it 4 $\frac{29}{60}$ times.

The Diameter of a *Fixed Star* of the *Third Magnitude* is unto the Diameter of the *Earth* as 25 unto 6: therefore it containeth it 4 $\frac{1}{6}$ times.

The Diameter of a *Fixed Star* of the *Fourth Magnitude* is unto the Diameter of the *Earth* as 19 and 5 : therefore it containeth it $3\frac{4}{5}$ times.

The Diameter of a *Fixed Star* of the *Fifth Magnitude* is unto the Diameter of the *Earth*, as 119 unto 36, therefore it containeth it $3\frac{11}{36}$ times.

The Diam. of a *Fixed Star* of the *Sixth Mag.* is unto the Diam. of the *Earth*, as 21 unto 8 ; therefore it containeth it $\frac{5}{8}$ times.

As for the Proportions of the Cloudy and Obſcure *Stars*, they are not expreſſed ; becauſe they are but few, and of no great account in reſpect of their ſmalneſs.

The Proportions of the Fixed Stars *compared with the* Globe *of the* Earth, *are as follow.*

A *Star* of the *Firſt Magnitude* is to the *Globe* of the *Earth*, as 6859 to 64, therefore it containeth the *Globe* of the *Earth* $107\frac{1}{5}$ times.

A *Star* of the *Second Magnitude* is to the *Globe* of the *Earth*, as 19465109 is to 216000, therefore it containeth it $90\frac{1}{8}$ times.

A *Star* of the *Third Magnitude* is to the *Globe* of the *Earth*, as 15625 is to 216, therefore it containeth it $72\frac{1}{3}$ times.

A *Star* of the *Fourth Magnitude* is to the *Globe* of the *Earth*, as 6850 is unto 125 : therefore it containeth the *Globe* of the *Earth* $54\frac{11}{11}$ times.

A *Star* of the *Fifth Magnitude* is to the *Globe* of the *Earth*, as 1685159 is unto 46656, therefore it containeth the *Globe* of the *Earth* $36\frac{1}{8}$ times.

A *Star* of the *Sixth Magnitude* is to the *Globe* of the *Earth*, as 9261 is unto 512, therefore it containeth the *Globe* of the *Earth* $18\frac{1}{19}$ times.

I confeſs all this may ſeem matter of incredulity to thoſe whoſe underſtanding is ſwayed by their viſual Sence, but if they be capable to conſider the vaſt diſtance of thoſe Huge Bodies (the *Stars*) from the face of the *Earth*, and alſo the diminutive quality of Diſtance, their reaſon will be rectified; and their incredulity turn'd into an acknowledgment of the unſpeakable Wiſdom of Almighty God ; and they will ſay with the *Pſalmiſt*, *Great is our Lord, Great is his Power, his Wiſdom is infinite*, *Pſal.* 147. 5.

The diſtance of the *Stars* therefore from the *Earth*, is according to Mr. *John Dee*'s Computation, 2008 $1\frac{1}{2}$ Semidiameters of the *Earth*. The Semidiameter of the *Earth* containeth of our common *Miles* $3436\frac{4}{11}$, Such *Miles* as the whole *Earth* and *Sea* round about is 21600: allowing for every *Degree* of the greateſt *Circle* 60 *Miles*: ſo that the diſtance of the *Stars* from the *Earth* is in Miles 69005540. Now as Mr. *Dee* ſaith (almoſt in the ſame words) if you weigh well with your ſelf this little parcel of Fruit *Aſtronomical*; as concerning the Bigneſs and Diſtance of the *Stars*, &c. and the huge maſſineſs of the *Starry Heaven*, you will find your Conſciences moved with the Kingly Prophet to ſing the Confeſſion of God's Glory; and ſay, *The Heavens declare the Glory of God, and the Firmament ſheweth forth the Works of his Hands.*

§ XIV. *Of the* Nature *of the* Stars.

To many of the Principal *Stars* there is in *Planetical* Characters prefixed their *Planetical Natures*. The *Aſtrologers* make great uſe of them for knowing the *Nature* of the *Stars*: for thoſe *Stars* that have the Character of ♄ adjoyned, are ſaid to be of the *Nature* of ♄: thoſe that have ♃ adjoyned, are of the *Nature* of ♃: and ſo of the reſt. If a *Star* have the Characters of two *Planets* adjoyned, that *Star* participates of both their *Natures*, but moſt of that *Planets* whoſe character is firſt placed.

The uſe *Aſtronomers* make of thoſe Characters, is for knowing the Colour of any *Star*; as if a *Star* have ♄ adjoyned, it is of the Colour of ♄; if ♃, it is the Colour of ♃, &c.

The *Fixed Stars* are known from the *Planets* by their continual Twinkling, for the *Planets* never Twinkle, but the *Fixed Stars* do.

§ XV. *Of* Via Lactea, *or the* Milky way.

This Subject, becauſe it is already ſo fully handled by Dr. *Hood*, that more than he hath Written cannot well be ſaid, either of his own Opinion or other Mens, I think fit therefore to give you his own Words, which are as follow,

VIA LACTEA, or *Circulus Lacteus* by the *Latines* ſo called; and by the *Greeks*, *Galaxia*, and by the *Engliſh* the *Milky way*. It is a broad white Circle that is ſeen in the *Heaven*: In the *North Hemiſphere*, it beginneth at *Cancer*, on each ſide the Head thereof, and paſſeth by *Auriga*, by *Perſeus*, and *Caſſiopeia*, the *Swan*, and the Head of *Capricorn*, the Tail of *Scorpio*, and the Feet of *Centaur*, *Argo* the *Ship*, and ſo unto the Head of *Cancer*. Some in a ſporting manner do call it *Watling-Street*, but why they call it ſo, I cannot tell; except it be in regard of the narrowneſs that it ſeemeth to have; or elſe in reſpect of that great High-way that lieth between *Dover* and St. *Albans*, which is called by our Men *Watling-Street*.

Concerning this Circle there are ſundry Opinions; for there is great difference among ſome Writers, both touching the Place, Matter, and Efficient Cauſe thereof. *Ariſtotle* diſſenteth from all other, both *Philoſophers* and *Poets*, in the *Place*, *Matter*, and *Cauſe* of this Circle; ſaying, That it is a *Meteor* ingendered in the *Air*, made of the *Vapours* of the *Earth*, drawn up thither by the Heat of the *Sun*, and there ſet on *Fire*. But his Opinion is of all Men confuted.

Firſt, Touching the Place, it cannot be in the *Air*; for whatſoever is in the *Air*, is not ſeen of all Men, at all Times, to be under one and the ſame Part of *Heaven*. If we ſee it in the *South*, they that are in the *Weſt* ſhall ſee it under the *Eaſt* ſide of the *Heaven*, and they that are in the *Eaſt*, ſhall ſee it in the *Weſt* Part of the *Heaven*; But this Circle is of all Men ſeen always under the ſame Part of *Heaven*, and to be joyned with the ſame *Stars*; therefore it cannot be in the *Air*.

Again, for the *Matter*, it cannot be made of that which *Ariſtotle* nameth (*i.e.*) the *Vapours* of the *Earth*, becauſe of the long continuance of the Thing, and that without any Alteration: for it is impoſſible that any *Meteor* made of *Vapours* drawn up from the *Water*, or *Exhalations* from the *Earth*, ſhould laſt ſo Long; as may be ſeen in *Blazing Stars*; which though they have continued long, as namely 16 Months, ſome more, ſome leſs; yet at the length they have vaniſhed away: whereas this Circle hath continued from the Beginning unto this Day. Beſides, put caſe it were made of theſe *Exhalations*; whence will they infer the uniformity thereof? The *Comets* do alter diverſly, both in the Faſhion of their Blazing, and alſo in their ſeveral Quantities; whereas in this Circle, there is nothing but the ſame Part, always of one Form and of one Bigneſs. In the Efficient Cauſe thereof he muſt needs err: for if it be neither in the *Air*, nor made of the Exhalations of the *Earth*, it cannot be cauſed by the *Sun*; for the one is the Place, and the other the Matter, wherein, and whereupon the *Sun* ſheweth his power.

All other (beſides *Ariſtole*) agree in the Place, but differ in the Efficient cauſe thereof; and they are either *Philoſophers*, or *Poets*. Both theſe affirm that it is in the *Firmament* (i.e.) in the *Eight Sphere*, but they diſagree in the Cauſe thereof.

The *Philoſophers* (and chiefly *Democritus*) affirm the Cauſe of the thing, to be the exceeding great number of *Stars* in that part of *Heaven*, whoſe Beams meeting together ſo confuſedly, and not coming diſtinctly to the Eye, cauſeth us to imagine ſuch a Whiteneſs as is ſeen. But the beſt Opinion is this, that this *Milky way* is a part of the *Firmament*, neither ſo thin as the other parts thereof are, nor yet ſo thick as the *Stars* themſelves. If it were as thin as the other Parts of the *Heaven* beſides the *Stars*, then could it not retain the light, but the light would paſs through it and not be ſeen: If it were as Thick as the *Stars*, then would the Light be ſo doubled in it, that it would Gliſter and Shine, as the *Stars* themſelves do: but being neither ſo thin as the one, nor ſo thick as the other, it becometh of that Whiteneſs we ſee. Thus far Dr. *Hood*, But

Our modern Philoſophers conceive this *Lactean* Whiteneſs ariſeth from a great number of little Stars, conſtipated in that part of *Heaven*; flying ſo ſwiftly from the ſight of our Eyes, that can perceive nothing but a confuſed Light; this is *Teleſcope* (more lately found out) doth evidently demonſtrate to us; by the Benefit of which, little Stars (otherwiſe inconſpicuous to our Eyes) are there clearly diſcerned.

About the Southern Pole are ſeen two *White Spots*, like little *Clouds*, coloured like the *via Lactea*, one of which is treble the *Latitude* of the other; ſome *Mariners* call them *Nubeculæ Magellani*.

This *Milkey way* is deſcribed on the *Globe* between two Tracks of ſmall Pricks running through the *Images* mentionned in the beginning of this Section.

Thus have you the definition of the *Globes*, with the Deſcription of all the *Lines*, *Circles*, &c. deſcribed thereon. I ſhall now explain unto you the meaning of ſeveral Words of Art, which in the Uſe of them you will meet with, and then come to the uſe it ſelf.

And firſt, what is meant by the word *Horizon*.

§ XVI.

When I ſpake of the *Horizon* before, I only mentioned the Wooden *Horizon*, or Frame about the *Globe*; which becauſe it repreſents the *Mathematical Horizon*, is therefore called the *Horizon*; but the word *Horizon* is to be conſidered more particularly two manner of ways: as

Firſt, the *Natural Horizon*.

Secondly, the *Mathematical Horizon*.

The *Natural Horizon* is that apparent Circle which divides the Viſible part of *Heaven* from the Inviſible; it extends it ſelf in a ſtraight Line from the Superficies of the *Earth*, every way round about the place you ſtand upon, even into the very circumference of the *Heavens*. It is only diſcerned at *Sea*, or on plain Ground, that is free from all hindrance of the Sight, as *Hills*, *Trees*, *Houſes*, &c.

The *Mathematical Horizon* (which indeed is meant in this Treatiſe, ſo oft as I ſhall have occaſion to name the word *Horizon*) is a great Circle which divides that part of *Heaven* which is above us, from that which is under us, preciſely into two equal parts; whoſe *Poles* are the *Zenith* and *Nadir*. In this Circle the *Azimuths* or *Vertical Circles* are numbred, and by this Circle our *Days* and *Nights* are meaſured out unto us; for while the *Sun* is above the *Horizon* it is *Day*; and when it is under the *Horizon* it is *Night*.

This Circle is repreſented unto us by the upper Plain of the Wooden *Horizon*: Therefore ſo oft as you are directed to bring any *Degree* or *Star*, &c. to the *Horizon*, it muſt be underſtood that you muſt turn the *Globe* till the *Degree* or *Star* come juſt to the upper Inner edge of the Wooden *Horizon*.

Zenith. The *Zenith* and *Nadir*, are two points oppoſite to one another. The *Zenith* is that point in *Heaven* directly over our Heads; *Nadir.* and the *Nadir* is that point in *Heaven* directly under our Feet.

Azimuths, or Vertical Circles. The *Azimuths*, or *Virtical Circles*, are great Circles, paſſing through the *Zenith* and *Nadir*, whoſe *Poles* are the *Zenith* and *Nadir*. And as the *Meridians* cut the *Equator* and all Parallels to the *Equator* at right Angles, ſo the *Azimuths* cut the *Horizon* and all *Almicanthars* at right Angles alſo. The *Azimuths* (as the *Meridians*) are infinite; and are numbered by *Degrees* from the *Eaſt* and *Weſt* points towards the *North* and *South* in the *Horizon*.

The

Almicanthars, or, Circles of Altitude.

The *Almicanthars* are Circles parallel to the *Horizon*, whoſe *Poles* are the *Zenith* and *Nadir*. They are ſo called *Circles of Altitude*, becauſe when the *Sun*, *Moon*, or any *Star* is in any number of Degrees above the *Horizon*, it is ſaid to have ſo many Degrees of *Altitude*; which Degrees of *Altitude* are numbred on the *Vertical Circle* from the *Horizon* upwards, towards the *Zenith*. The *Almicanthars* are alſo infinite, as *Parallels*, *Meridians* and *Azimuths* are.

Amplitude.

The *Amplitude* is the number of Degrees contained between the true *Eaſt* or *Weſt* point towards the *North* or *South* points of the *Horizon*, and the *Riſing* or *Setting* of the *Sun*, *Moon*, or *Stars*, &c.

Declination.

The *Declination* is the number of Degrees that the *Sun*, *Moon*, or any *Star* is diſtant from the *Equinoctial* towards either *Pole*, and hath a double denomination, *viz.* *North Declination*, and *South Declination*; for if the *Sun*, *Moon*, or *Stars* ſwerve towards the *North Pole*, they are ſaid to have *North Declination*, if towards the *South Pole*, *South Declination*.

Right Aſcenſion

The *Right Aſcenſion* is the number of Degrees of the *Equinoctial* (accounted from the firſt point of *Aries*) which comes to the *Meridian* with the *Sun*, *Moon*, or *Stars*, or any other point in *Heaven* propoſed.

Oblique Aſcenſion.

The *Oblique Aſcenſion* is the number of Degrees of the *Equinoctial* which comes to the *Eaſt* ſide the *Horizon* with *Sun*, *Moon*, or any *Star*.

Oblique Deſcenſion.

The *Oblique Deſcenſion* is the Degrees of the *Equinoctial*, which comes to the *Weſt* ſide the *Horizon* with the *Sun*, *Moon*, or any *Star*.

Aſcenſional Difference.

The *Aſcenſional Difference* is the number of Degrees after Subſtraction of the *Oblique Aſcenſion* from the *Right Aſcenſion*.

Raiſe the Pole
Depreſs the Pole

So many Degrees as you Sail towards the *Pole*, you are ſaid to *Raiſe the Pole*; and ſo many Degrees as you Sail from the *Pole*, you are ſaid to *Depreſs the Pole*.

Courſe.

Courſe is the *point of the Compaſs* you Sail upon; as if you Sail *Eaſtward*, it is an *Eaſterly Courſe*, if *VVeſt*, a *Weſterly Courſe*, &c.

Diſtance.

Diſtance is the number of *Leagues* you have Sailed from any place, upon any *Courſe*.

Zone.

A *Zone* is a ſpace of the *Earth*, contained between two *Parallels*. The Ancient *Geographers* made five *Zones* in the *Earth*; two *Frozen*, two *Temperate*, and one *Burnt Zone*.

Frozen Zone.

The two *Frozen Zones* are thoſe parts of the *Globe* comprehended between the *North Pole* and the *Antarctick Circle*, and the *South Pole* and the *Antarctick Circle*; by the Ancients called *Inhabitable*, becauſe the *Sun* being always far remote from them ſhoots its Beams obliquely upon them, which oblique Beams are ſo very weak, that all their *Summer* is but a continued *Winter*, and the *Winter* (as they thought) impoſſible to be at all indured.

Temperate Zone

The *Temperate Zones* are the ſpace of *Earth* contained between the *Arctick Circle* and the *Tropick of* ♋, and the *Antarctick Circle* and the *Tropick of* ♑, by the Ancients called *Temperate* and *Habitable*; becauſe they are compoſed of a ſweet mediocrity, between outragious Heat, and extremity of Cold.

Burnt Zone.

The *Burnt Zone* is the ſpace of *Earth* contained between the *Tropick* of ♋, and the *Tropick* of ♑, called by the Antients *Unhabitable*, becauſe in regard the *Sun* never moves out of this *Zone*, but darts is Beams perpendicularly upon it, they imagined the Air was ſo unſufferable Hot, that it was impoſſible for any to Inhabit in this *Zone*; ſo that (as you ſee) they held the two *Temperate Zones* only habitable, and the two *Frozen Zones* and one *Burnt Zone* altogether impoſſible to be Inhabited. But their Succeſſors, either animated by induſtry, or compelled by neceſſity, have apparently refuted their Aſſertion; for at this time many thouſands can witneſs that their Bloods are not ſo greaſie as to Melt in the ſcorching Heat of the One, or ſo Watry as to Congeal in the *Icy* Froſts of the other.

Climates.

The Antients have yet otherwiſe divided the *Earth* into four and twenty *Northern Climates*, and four and twenty *Southern Climates*; ſo that in all there is eight and forty *Climates*. The *Climates* are altered according to the half Hourly increaſing of the longeſt Days; for in the *Latitude* where the longeſt Days are increaſed half an Hour longer than they are at the *Equator* (viz. longer than 12 Hours) the firſt *Climate* begins; and in the *Latitude* where they are increaſed an whole Hour longer than in the *Equator*, the ſecond *Climate* begins, where the days are increaſed three half hours longer than in the *Equator*, the third *Climate* begins; and ſo onwards, the *Climates* alter according as the longeſt Day increaſes half an Hour, till you come to find the longeſt day 24 Hours long.

Now the Antients (in thoſe Times) knowing no more than nine *Habitable Climates*, gave names only to nine. The firſt they called *Dia Meros*, after the name of a famous Inland Iſland, which is ſituate about the middle of that *Climate*, and is now called *Gueguere*. The ſecond *Climate* they called *Dia Syenes*, after the name of an eminent *City* in *Ægypt*, lying about the midſt of that *Climates*. The third *Dia Alexanderas*, after the name of the Metropolitan *City* of *Ægypt*. The fourth *Dia Rhodes*. The fifth *Dia Rhomes*. The ſixth *Dia Ponton*. The ſeventh *Dia Boriſthenees*. The eighth *Dia Ripheos*. The ninth *Dia Daniam*.

Theſe Names belong only to the *Climates* on the *North* ſide of the *Equator*. But thoſe on the *South* ſide (in regard of the ſmall *Diſcoveries* thoſe Ages had on that ſide the *Equator*) were diſtinguiſht only by the addition of the word *Anti*, to the ſame *Southerly Climate*; as the firſt *Southern Climate* (which is that *Climate* that lies as many Degrees to the *Southward* as the firſt doth to the *Northward*) they called *Anti Moroes*. The ſecond *Anti Syenes*. The third *Anti Alexanderas*, and ſo on to the ninth.

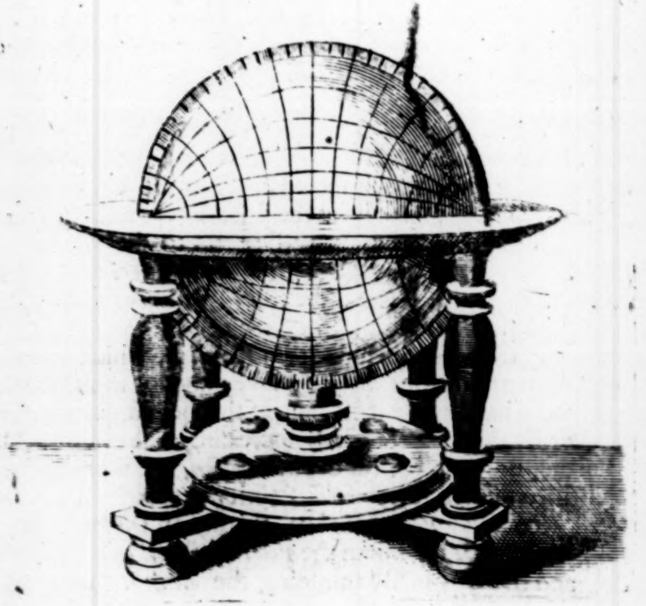
In every *Climate* is included two *Parallels*, which are of the ſame Nature with the *Climates*; ſave only that as the *Climates* alter by the half hourly increaſing of the longeſt day, the parallels alter by the Quater Hourly increaſing of the longeſt Day. *Parallels.*

Furthermore, in reſpect of the *Horizon*, we find the *Sphere* conſtituted into a three-fold Poſition; as firſt into a *Direct Sphere*, ſecondly a *Parallel Sphere*, thirdly an *Oblique* *Sphere*.

A *Direct Sphere* hath both the *Poles* of the *World* in the *Horizon*, and the *Equinoctial* tranſiting the *Zenith*. In a *Direct Sphere* all the Circles parallel to the *Equator* make right Angles with the *Horizon*, and are alſo divided into two equal parts by the *Horizon*; and in a *Direct Sphere* the *Sun*, *Moon*, and *Stars* are always twelve Hours above the *Horizon*, and twelve Hours under the *Horizon*, and conſequently make twelve Hours Day, and twelve Hours Night. *Direct Sphere.*

It is called a *Direct Sphere*, becauſe all the *Celeſtial* Bodies, as *Sun*, *Moon*, and *Stars*, &c. by the *Diurnal* Motion of the *Primum Mobile*, aſcend directly Above, and deſcend directly Below the *Horizon*.

They that Inhabit under the *Equator*, have the *Sphere* thus poſited; as in the Iſland *Borneo*, *Sumatra*, *Celebes*, St. *Thomas*, a great part of *Africk*, *Peru* in the *Weſt-Indies*, &c. as you may ſee by the *Globe* it ſelf; if you move the *Braſen Meridian* through the notches in the *Horizon*, till the *Poles* thereof touch the *Horizon*. As in the Figure.



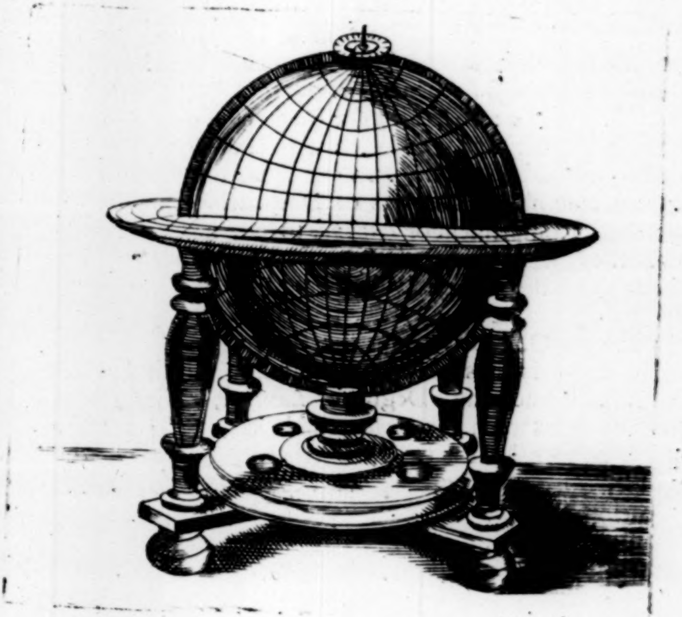
Parallel Sphere

A *Parallel Sphere* hath one *Pole* of the *World* in the *Zenith*, the other in the *Nadir*, and the *Equinoctial* line in the *Horizon*.

In a *Parallel Sphere*, all the Circles Parallel to the *Equinoctial*, are alſo Parallel to the *Horizon*, and in a *Parallel Sphere* from the 10*th*. of *March* to the 13*th*. of *September* (the *Sun* being then in the *Northerly Signs*, and conſequently on the *North* ſide the *Horizon*) there is ſix Months Day in the *North*, and ſix Months Night in the *South*; and contrarily from the 13 of *September* to the 10 of *March* (the *Sun* being then in the *Southerly Signs*, and therefore on the *South* ſide the *Horizon*) there is ſix Months Day in the *South*, and ſix Months Night in the North.

It is called a *Parallel Sphere*, Becauſe the *Sun*, *Moon*, or *Stars* in a Diurnal Revolution of the *Heavens*, neither aſcend Higher or deſcend Lower, but always move parallel to the *Horizon*.

The *Earth* is thus poſited under both the *Poles*, viz. in 90 Degrees of *Latitude*; as may be ſeen by the *Globe*, if you turn the *Brazen Meridian* till either of the *Poles* be elevated 90 Degrees above the *Horizon*. As in this Figure.



Oblique Sphere.

An *Oblique Sphere* hath the *Axis* of the *World* neither *Direct* or *Parallel* to the *Horizon*, but lies a-ſlope from it.

In an *Oblique Sphere* all the *Celeſtial* Bodies, as *Sun*, *Moon*, or *Stars*, &c. have (in reſpect of the *Horizon*) oblique and unequal Aſcenſions and Deſcenſions, and all the Lines parallel to the

Equator

Equiator make unequal Angles with the *Horizon*, and are cut by the *Horizon* into unequal parts; for thoſe lines towards the elevated *Pole*, have a greater portion of a Circle under the *Horizon* than above it; only the *Equator* becauſe it hath the ſame Center with the *Horizon*, doth divide the *Horizon* into two equal parts, and is alſo divided into two equal parts by the *Horizon*.

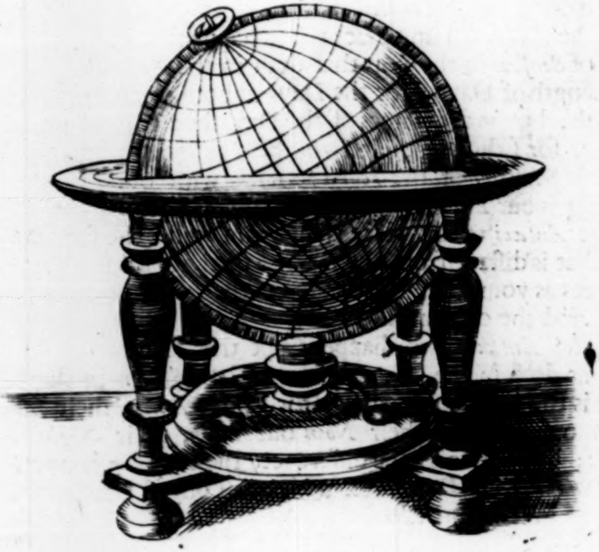
Hence it follows, that when the *Sun* is in any part of the *Ecliptick* that declines towards the elevated *Pole*, the Days in the elevated *Hemiſphere* ſhall be longer than the Nights; and when the *Sun* is in any part of the *Ecliptick* that Declines towards the depreſſed *Pole*, the Nights ſhall be longer than the Days. But when the *Sun* is in the *Equinoctial* (becauſe whether the *Pole* be *Raiſed* or *Depreſſed*) equal portions remain both above and under the *Horizon*; therefore the Days are of the ſame length with the Nights, and the Nights with the Days.

Alſo in an *Olique Sphere*, all thoſe *Stars* that have as great or greater number of Degrees of Declination than is the elevated *Poles* Complement of *Latitude* to 90, never ſet or come under the *Horizon*, and thoſe *Stars* that have the ſame Declination about the *Depreſſed Pole*, never Riſe.

It is called an *Oblique Sphere*, becauſe all the Circles of the *Sphere* move Obliquely about the *Horizon*.

The *Earth* is thus obliquely poſited to all thoſe Nations that Inhabit under any Degree of *Latitude*, either *North* or *Southwards*, between the *Equator* and either *Pole*: as may variouſly be ſeen by the *Globe*, when the *Axis* lies not on the *Horizon*, nor the *Equator* is parallel to the *Horizon*; As in this following Figure.

Moreover



Moreover, all Places have their *Antipodes*, *Periæci* and *Antæci*.

The *Antipodes* of any Place is the oppoſite Degree on the *Globe*. As if a Perpendicular were let fall from the Place you ſtand on, through the Center of the *Earth*, and continued till it paſs quite through the Superficies of the *Earth*, on the other ſide; then in the point where the Perpendicular cuts the Superficies of the *Earth* on the other ſide, is the *Antipodes* of that Place.

The Inhabitants of any two Places that are in *Antipodes* to each other, go with their Feet directly againſt one another, and have a contrarity in the *Seaſons* of the Year, and *Riſings* and *Settings* of the *Sun*, *Moon*, or *Stars*, and all other of the *Heavenly* Bodies; ſo that when with Us it is *Spring*, with Them it is *Autumn*; when with Us the *Sun* Riſes, in our *Antipodes* it Sets; and therfore their *Morning* is our *Evening*, their *Noon* our *Midnight*,

night, their *Evening* our *Morning*; and their Longeſt Day our Shorteſt.

The *Periæci* of any place is that point in the ſame *Parallel* which comes to the *Meridian* with the *Antipodes*.

In the *Periæci* of any Place there happens not that Contrariety of *Seaſons* in the Year that doth in the *Antipodes*; nor in the Length of Days; for the Days in both places are of equal Length; but in the Times of the Day, there is the ſame contrarity, for (though their *Spring* be our *Spring*) and the reſt of their Seaſons of the *Year* the ſame with ours, yet) their *Morning* is our *Evening*, their *Night* our *Day*, &c.

The *Antæci* of any Place is the point under the ſame *Meridian* that is diſtant from the *Equator* on the *South* ſide ſo many Degrees as your Place is diſtant from the *Equator* on the *North* ſide; and the contrary.

In the *Antæci* there happens not that contrariety in the Days as doth in the *Antipodes*, but in the *Seaſons* of the Year there is the ſame contrariety; for in our *Antæci* their *Morning* is our *Morning*, their *Noon* our *Noon*, their *Night* our *Night*; but herein is the difference, their *Spring* is our *Fall*, their *Summer* our *Winter*, &c. and their Longeſt Day our Shorteſt; as in the *Antipodes*.

The SECOND BOOK:

Shewing the Practical Uſe of the

LIBRARY

GLOBES.

Applying them to the Solution of Aſtronomical *and* Geographical *Problems.*

PREFACE.

Some Advertiſements in *Chooſing* and *Uſing* the GLOBES.

1. S*EE the Papers be well and neatly paſted, on the* Globe; *which you may know, if the Lines and Circles deſcribed thereon meet exactly, and continue all the way even and whole; the Lines not ſwerving out or in, and the Circles not breaking into ſeveral Arches; nor the Papers either come ſhort, or lap over on the other.*

2. *See that the Colour be tranſparent, and lay not too thick on the* Globe; *leſt it hide the Superficial Deſcriptions.*

3. *See the* Globe *Hang evenly between the* Meridian *and* Horizon; *not inclining more to the one ſide than the other.*

4. *See the* Globe *Swim as cloſe to the* Meridian *and*

Horizon *as conveniently it may; leſt you be too much puzzled to find againſt what point of the* Globe *any Degree of the* Horizon *or* Meridian *is.*

5. *See the* Equinoctial Line *be one with the* Horizon, *when the* Globe *is ſet in a* Parallel Sphere.

6. *See the* Equinoctial Line *cut the* Eaſt *and* Weſt *point of the* Horizon, *when the* Globe *is ſet to an* Oblique Sphere.

7. *See the Degrees of the* Meridian *maked with* 90 *and* 00, *Hand exactly over the* Equinoctial Line *of the* Globe.

8. *See that exactly half the* Meridian *be above the* Horizon, *and half under the* Horizon; *which you may know if you bring any of the Decimal Diviſions to the* North *ſide of the* Horizon, *and find their Complement to* 90 *in the* South.

9. *See that when the* Quadrant of Altitude *is placed at the* Zenith, *the beginning of the Graduations reach juſt to the Superficies of the* Horizon.

10. *See that while the* Index *of the* Hour Circle *(by the motion of the* Globe*) paſſes from one* Hour *to the other,* 15 *Degrees of the* Equator *paſs through the* Meridian.

11. *If you have a* Circle of Poſition, *ſee the Graduations agree with thoſe of the* Horizon.

12. *See that your Wooden* Horizons *be made ſubſtantial and ſtrong; for (beſides the Inconveniencies that thin Wook is ſubject unto, in reſpect of warping and ſhrinking) I have had few* Globes *come to mending that have not had either brokes* Horizon, *or ſome other notorious fault, occaſioned through the ſleightneſs of the* Horizon.

In the Uſing of the Globes.

K*Eep the* Eaſt *ſide of the* Horizon *always towards you, unleſs your Propoſition requires the turning of it; which* Eaſt *ſide you may know by the Word* Eaſt, *placed*

ced on the outmoſt verge thereof. For then have you the graduated ſide of the Meridian *always towards you, the* Quadrant of Altitude *before you, and the* Globe *divided into two equal parts.*

So oft as I name to, at, of *or* under the Meridian, *or* Horizon, *I mean the* Eaſt *ſide of the* Meridian, *and Superficies of the* Horizon; *becauſe the* Eaſt *ſide of the* Meridian *paſſes through the* North *and* South *points, both of the* Globe *and* Horizon; *and agrees juſt with the middle of the* Axis: *And the Superficies of the* Horizon *divideth the* Globe *exactly into two equal parts.*

If you happen to uſe the Globes *on the* South *ſide the* Equator, *you muſt draw the Wyers out of either* Pole, *and change them to the contrary* Poles; *putting the longeſt Wyer into the* South Pole. *And becauſe on the other ſide the* Equator *the* South Pole *is elevated, therefore you muſt elevate the* South Pole *of the* Globe *above the* Horizon, *according to the* South Latitude *of your Place; as ſhall be ſhewed hereafter.*

In the working ſome Problems *it will be required that your turn the* Globe *to look on the* Weſt *ſide thereof; which turning will be apt to jog the* Ball, *ſo as the Degrees that was at the* Horizon *or* Meridian, *will be moved away, and thereby the Poſition of the* Globe *altered: To avoid which inconvenience you may make uſe of a Quill, thruſting the Feather end between the* Ball *and the* Brazen Meridian, *and ſo wedge it up, without wronging the* Globe *at all, till your Propoſition be anſwered.*

PROB. I.

To find the Longitude *and* Latitude *of* Places *on the* Terreſtrial Globe.

SEek the *Place* on the *Terreſtrial Globe*, whoſe *Longitude* and *Latitude* you would know, and bring the *Place* to the

Brazen Meridian; and ſee how many Degrees of the *Equator*, is cut by the *Meridian*, from the Firſt general *Meridian* (which on my *Globes* paſs through *Gratioſa*, one of the Iſles of the *Azores*) for that number of Degrees is the *Longitude* of the *Place*.

Example.

I deſire to know the *Longitude* of *London*, and cloſe to the name *London* I find a ſmall mark o thus (which ſmall mark is in ſome *Globes* and *Maps* adorned with the Picture of a Steeple. *&c.*) therefore I do not bring the word *London* to the *Meridian*, but that ſmall mark; for that always repreſents the Town or City ſought for: And keeping the *Globe* ſteddy in this Poſition, I examine how many Degrees of the *Equator* are contained between the *Brazen Meridian*, and the firſt general *Meridian*; which I find to be 27 Deg. 15. min. Therefore I ſay the *Longitude* of *London* is 27 Deg. 15 min.]

For the Latitude.

See on the *Brazen Meridian* how many Degrees are contained between the *Equator* and the mark for *London*, which in this Example is $15\frac{1}{2}$; therefore I ſay *London* hath $15\frac{1}{2}$ *North Latitude*.

PROB. II.

The Longitude *and* Latitude *being known, to Rectifie the* Globe *fit for Uſe*.

1. WHen you Rectifie the *Globe* to any particular *Latitude*, you muſt move the *Brazen Meridian* through the notches of the *Horizon*, till the ſame number of Degrees accounted on the *Meridian* from the *Pole* (about which the *Hour Circle* is) towards the *North* point in the *Horizon* (if in *North Latitude*, and toward the *South* if in *South Latitude*) come juſt to the edge of the *Horizon*.

Example.

By the former Propoſition I found the *Latitude* of *London* to be 51½ Degrees *North Latitude*; therefore I count 51½ Degrees from the *Pole* downwards towards my right Hand, and turn the *Meridian* through the Notches of the *Horizon* till thoſe 51½ Degrees come exactly to the uppermoſt edge of the *North* point in the *Horizon*; and then is the *Meridian* rectified to the *Latitude* of *London*.

2. Next Rectifie the *Quadrant of Altitude*, after this manner. Screw the edge of the *Nut* that is even with the Graduated edge of the thin Plate, to 51½ Degrees of the *Brazen Meridian*, accounted from the *Equinoctial* on the *Southern* ſide the *Horizon*, which is juſt the *Zenith* of *London*; and then is your *Quadrant* Rectified.

3. Bring the Degree of the *Ecliptick* the *Sun* is in that Day to the *Meridian*; which you may learn to know by the next Probleme, and then turn the *Index* of the *Hour Circle* to the Hour 12. on the *South* ſide the *Hour Circle*, and then is your *Hour Circle* alſo Rectified fit to uſe for that Day.

4. Laſtly, If you will Rectifie the *Globe* to correſpond in all reſpects with the Poſition and Situation of the *Sphere*; you muſt ſet the four Quarters of the *Horizon*, *viz. Eaſt*, *Weſt North*, and *South*, agreeable with the four Quarters of the World; which you may do by the *Needle* in the Bottom of the *Horizon*; for you muſt turn the *Globe* ſo long till the *Needle* point juſt to the *Flower-de-Luce*. Next you muſt ſet the Plain of the Wooden *Horizon* parallel to the *Horizon* of the *World*; which you may try by ſetting a common *Level* to the four Quarters of the *Horizon*. And then poſiting the Degree of the *Ecliptick* the *Sun* is in to the Heighth above or Depth below the *Horizon* the *Sun* hath in *Heaven* (as by Prob. 11.) your *Globe* is made correſpondent in all points with the frame of the *Sphere*, for that particular *Time* and *Latitude*.

PROB. III.

To find the Place of the Sun *in the* Ecliptick, *the Day of the Month being firſt known.*

SEek the Day of the Month in the Circle of Months, upon the *Horizon*, and right againſt it in the Circle of *Signs* is the Degree of the *Ecliptick* the *Sun* is in.

Example.

Example.

Imagine the Day to be given is *May* 10. therefore I ſeek on the *Horizon* in the Circle of Months, for *May*, and find the Months divided into ſo many parts as there is Days in the Month; which parts are marked with Arithmetical Figures, from the beginning of the Month to the end, and denote the number of the Day of the Month that each Diviſion repreſents; therefore among the Diviſions I ſeek for 10, and directly againſt it in the Circle of *Signs*, I find ♉ 29 Degrees. Therefore I ſay, *May* 10. the *Suns* Place is 29 Degrees of ♉.

But note, That if it be *Leap Year*, inſtead of the 10th of *May*, you muſt take the 11th of *May*, becauſe *February* having in a *Leap-Year* 29 Days, the 29 of *February* muſt be reckoned for the firſt of *March*; and the firſt of *March* for the ſecond of *March*; the ſecond of *March* for the third of *March*, and ſo throughout the Year.

The *Leap-Year* is cauſed by the ſix odd Hours more than 365 Days that are aſſigned to every Common Year; ſo that in Revolution of 4 Years, one Day is gained, which is added to *February*; and therefore *February* hath every fourth or *Leap-year* 29 Days.

PROB. IV.

To find the day of the Month, the Place of the Sun *being given.*

AS in the laſt Probleme it was your Task to find on the *Horizon* the Day of the Month firſt, ſo now you muſt firſt ſeek the *Sign* and *Degree* the *Sun* is in, and againſt it in the Circle of Months you ſhall ſee the Day of the Month; as againſt ♉ you have *May* 10.

PROB. V.

The Place of the Sun *given to find its* Declination.

HAving by the third Probleme found the *Suns* Place on the Plain of the *Horizon*, you muſt ſeek the ſame Degree in the *Ecliptick*, on the *Globe*; then bring that Degree to the *Brazen Meridian*; and the number of Degrees of the *Brazen Meridian* intercepted between the *Equinoctial* and the Degree juſt over the Degree of the *Ecliptick* the *Sun* is in; is the *Declination of the Sun* for that Day; and bears its Denomination of *North*, or *South*, according to its Poſition either on the *North* or *South* ſide the *Equinoctial*.

Example.

By the third Probleme aforeſaid, of *May* 10, I find ♉ 29. the *Suns* place; therefore I ſeek in the *Ecliptick* Line on the *Globe* for ♉ 29, and bring it to the *Eaſt* ſide the *Brazen Meridian*, which is the Graduated ſide; and over ♉ 29, I find on the *Brazen Meridian* 20 Deg. 5 Min. (numbred from the *Equinoctial*;) and becauſe ♉ is on the *North* ſide the *Equinoctial*, therefore I ſay, the *Sun* hath *May* 10 *North Declination* 20 Degrees 5 Min.

PROB. VI.

The Place of the Sun *given, to find its* Meridian Altitude.

THe *Globe* Rectified, Bring the Degree of the *Sun* to the *Meridian* (or which is all one, the Degree of the *Ecliptick* the *Sun* is in;) and the number of Degrees contained between the *Horizon* and the *Suns* place in the *Meridian*, is the number of Degrees that the *Sun* is Elevated above the *Horizon* at Noon, or (which is all one) the *Meridian Altitude of the Sun*.

Example.

To know what *Meridian Altitude* the *Sun* hath here at *London*, *May* 10. I bring the *Suns* place (found by the third Probleme) to the *Meridian*, and count on the *Meridian* the number of Degrees contained between the *Horizon* and the Degree juſt over the *Suns* place; which in this *Example* I find to be 58 ½. Therefore I ſay the *Suns Meridian Altitude May* 10. is here at *London* 58 ½ Degrees.

PROB. VII.

The Suns Place *given, to find the* Hour of Sun Riſing, *and the Length of the* Night *and* Day.

THe *Globe* and *Hour Index* Rectified, ſeek the Degree the *Sun* is in on the *Globe*, and bring that Degree to the *Eaſtern*

Side of the Horizon; and the *Index* of the *Hour-Circle* will point at the Hour of *Sun-Riſing*.

Example.

To know the Hour of *Sun-Riſing* here at *London*, *May* 10. The *Suns* place (as before) is 29 ♉, therefore the *Globe* being Rectified (as before) I ſeek ♉ 29 Degrees on the *Globe*, and bring that Degree to the *Eaſt* ſide of the *Horizon*; and looking on the *Index* of the *Hour-circle*, I find it point at 4 a Clock, and $\frac{1}{6}$ part of an Hour more towards 5; therefore, I ſay, *May* 10. the *Sun* Riſes here at *London* at $\frac{1}{6}$ (which is 10 Minutes) after 4 a Clock in the Morning.

If you double 4 Hours 10 Minutes it gives you the Length of the Night, 8 Hours 20 Minutes: And if you ſubſtract the Length of the Night 8 Hours 20 Minutes from 24 Hours, the Length of Day and Night; it leaves the Length of the Day 15 Hours 40 Minutes.

PROB. VIII.

To find the Hour of Sun Set.

TUrn the place of the *Sun* to the *Weſt* ſide of the *Horizon* and the *Index* of the *Hour Circle* ſhews on the *Hour Circle* the Hour of *Sun* Set; which on the 10th of *May* aforeſaid, is $\frac{4}{5}$ parts of an Hour after 7 a Clock at Night, *viz.* the *Sun* ſets at 48 Minutes paſt 7 a Clock.

PROB. IX.

To find how long it is Twilight *in the Morning & Evening.*

T*Wilight* is that promiſcuous and doubtful Light which appears before the Riſing of the *Sun* in the Morning, and continues after the Setting of the *Sun* in the Evening: It is made by the extenſion of the *Sun* Beams into the Vapours of the *Air*; when the *Sun* is leſs than 18 Deg. below the *Horizon*; for the *Sun* ere it Riſes, and after it ſets, ſhoots forth its Beams through the *Air*, and ſo illuminates the Vapours of the *Air*; which illumination does by degrees enlighten the *Horizon*; and ſpreads through the *Zenith*, even in the *Weſt* ere the *Sun* Riſes; and alſo continues above the *Horizon* after the *Sun* Sets.

Now though it be *Twilight* when the *Sun* is 18 Degrees below the *Horizon*; yet the Duration of *Twilight* is alterable, both in reſpect of *Time* and *Place*, for at ſuch *Time* as the *Sun* is fartheſt diſtant from any *Place*, the *Twilight* ſhall be Greater, than when it is nearneſt. And in reſpect of *Place*, All Places that have great *Latitude* from the *Equator*, have longer *Twilight* than thoſe that are nearer to the *Equator*; for as Authors ſay, under the *Equator* there is no *Twilight*; when again in many *Climes* both *Northward* and *Southward*, the Nights are indeed no Nights, but only (as it were) a little over-ſpread with an obſcure Shade; and it is either increaſed or diminiſhed according to the mutation of *Meteorological* Cauſes.

Therefore to know the beginning of *Twilight* in the Morning here at *London*, *May* 10, you muſt (having the *Globe* rectified) turn the Degree of the *Ecliptick* which is oppoſite to the Place of the *Sun* (*viz.* m.29) till it be elevated 18 Degrees in the *Quadrant of Altitude* above the *Horizon* in the *Weſt*; ſo ſhall 29. Deg. of ♉ be depreſſed 18 Deg. below the *Horizon* in the Eaſt ſide; and the *Index* of the *Hour Circle* point at the Hour that *Twilight* begins: then ſubſtract the Hour and Minute that *Twilight* begins from the Hour and Minute of *Sun* Riſing, if in the Morning; or ſubſtract the Hour of *Sun* Set from the Hour of *Twilight*, if at Night, and the Remainder is the length of Twilight.

Example.

The *Globe*, *Quadrant*, and *Hour-Index* being Rectified, as before; and the *Suns* place given ♉ 29. I ſeek the oppoſite Degree on the *Globe* after this manner: I bring ♉ 29. to the *Meridian*, and obſerve what Degree of the *Ecliptick* the oppoſite part of the *Meridian* cuts; and becauſe I find it cuts ♏ 29. therefore I ſay ♏ 29. is oppoſite to ♉ 29. having found the oppoſite Degree, I bring it into the *Weſt*, and alſo the *Quadrant of Altitude*, and joyn ♏ 29 to 18 Degrees (accounted upwards on the *Quadrant*) ſo ſhall ♉ 29 be depreſſed 18 Degrees in the *Eaſt* ſide the *Horizon*; then looking what Hour the *Hour-Index* points at in the *Hour-Circle*, I find it to be 1 Hour 8 Min. which ſhews that *Twilight* begins at 8 Minutes paſt 1 a Clock in the Morning.

And if you ſubſtract 1 Hour 8 Minutes, from 4 Hours 11 Minutes, the Time of *Sun* Riſing found by the 7th Probleme, it leaves 3 Hours 3 Minutes for the Length of *Twilight*: And if you double 1 Hour 8 Minutes, the Beginning of *Twilight*, it makes 2 Hours 16 Minutes for the intermiſſion of Time between *Twilight* in the Evening, and *Twilight* in the Morning; So that *May* 10. abſolute Night is but 2 Hours 16 Minutes Long, here at *London*.

The Reaſon why you bring the Degree oppoſite to the *Suns* place to the *Weſt*, is, becauſe the *Quadrant* containing but 90 Degrees will reach no lower than the *Horizon*, but this Probleme requires it to reach 18 Degrees beneath it; therefore by this Help, you have the Propoſition anſwered, as well as if the *Quadrant* did actually reach 18 Degrees below the *Horizon*. This ſhift you may have occaſion to make in ſome other Problemes.

If you would know when *Twilight* ends after the *Sun* Sets; you ſhall find it by bringing the Degree of the *Ecliptick* oppoſite to the place of the *Sun* to 18 Degrees of the *Quadrant of Altitude*, on the *Eaſt* ſide the *Horizon*; for then ſhall the *Index* of the *Hour-Circle* point at 10 Hours 52 Minutes; which ſhews that it continues *Twilight* till 52 Minutes paſt 10 a Clock at Night, *May* 10. here at *London*.

PROB. X.

The Suns *Place given, to find its* Amplitude; *And alſo to know upon what* point of the Compaſs *it* Riſeth.

THe *Globe* &c, Rectified: Bring the *Suns* place to the *Eaſt* ſide the *Horizon*; and the number of Degrees intercepted between the *Eaſt* point of the *Horizon* and the *Suns* place, is the number of Degrees of *Amplitude* that the *Sun* hath at its Riſing; and bears its denomination either of *North* or *South*, according to its inclination to either point in the *Horizon*.

Or if you would know upon what *Point of the Compaſs* the *Sun* Riſes; look but in the Circle of *Winds*, and againſt the place of the *Sun* you have the name of the *point of the Compaſs* upon which the *Sun* Riſeth.

Examples of both.

May 10. the *Suns* place is ♉ 29. Therfore the *Globe* being rectified; I bring ♉ 29. to the *Eaſt* ſide the *Horizon*, and find it touch againſt 33 Degrees 20 Minutes from the *Eaſt* point towards the *North*: Therefore I ſay the *Sun* hath *North Amplitude* 33 Degrees 20 Minutes.

And to know upon what *point of the Compaſs* the *Sun* Riſes; I keep the *Globe* to its Poſition, and look in the Circle of *Winds*, in the outmoſt Verge of the *Horizon*, and find the *Suns* place againſt the *Wind*, named *North Eaſt and by Eaſt*; therefore I ſay *May* 10. here at *London*, the *Sun* Riſeth upon the *North Eaſt and by Eaſt point* of the *Compaſs*.

PROB. XI.

The Day of the Month and Hour of the Day given, to find the Height of the Sun, *in any given* Latitude.

THe *Globe*, &c. Rectified, turn about the *Globe* till the *Index* of the *Hour-Circle* point (in the *Hour-Circle*) to the Hour of the Day; then bring the *Quadrant of Altitude* to the *Suns* place in the *Ecliptick*, and the Degree on the *Quadrant* which touches the *Suns* place, ſhall be the number of Degrees of the *Suns Altitude*.

Example.

May 10. here at *London*; at 53 Minutes paſt 8 a Clock in the Morning, I would know the Height of the *Sun* above the *Horizon*. Therefore I turn about the *Globe* till the *Index* of the *Hour-Circle* comes to 53 Minutes paſt 8 a Clock (which is almoſt 9) in the *Hour-Circle*: And keeping the *Globe* to this poſition, I bring the *Quadrant of Altitude* to the *Suns* place, *viz.* ♉ 29 (found by the third Probleme;) and becauſe the *Suns* place touches upon 40 Degrees of the *Quadrant*, therefore I ſay *May* 10. 53 Minutes paſt 8 a Clock in the Morning, here at *London*, The *Sun* is juſt 40 Degrees above the *Horizon*; or which is all one, hath 40 Degrees of *Altitude*.

PROB. XII.

The Altitude *of the* Sun *and Day of the Month given, to find the Hour of the Day.*

AN Hour is the 24th part of a Day and a Night, or the ſpace of Time that 15 Degrees of the *Equator* takes up in paſſing through the *Meridian*; for the whole *Equator* which contains 360 Degrees, paſſes through the *Meridian* in 24 Hours, therefore 15 Degrees which is the 24th part of 360 paſs through in one Hour. Theſe Hours are vulgarly divided into Halfs, Quarters,

ters and Half quarters; but Mathematically into Minutes, Seconds, Thirds, Fourths, *&c.* A Minute is the 60 part of an Hour, ſo that 60 Minutes make an Hour; 30 Half an Hour; 15 a Quarter of an Hour: A Second is the 60 part of a Minute; a Third is the 60 part of a Second: A Fourth is the 60 part of a Third; and ſo you may run on to Fifths, Sixths, Sevenths, &c. if you pleaſe; 12 of theſe Hours make a Day, and 12 more make a Night; ſo that Day and Night contain 24 Hours, as aforeſaid; which are vulgarly numbred from Noon with 1, 2, 3, to 12, at Night; and then begin again with 1, 2, 3, till 12, at Noon: But by *Aſtronomers* they are numbred from Noon with 1, 2, 3, *&c.* till 12 at Night, and ſo forward to 13, 14, 15, till 24, which is juſt full Noon the next Day. Yet in this Treatiſe I ſhall mention the Hours as they are vulgarly counted, *viz.* from 1 Afternoon till 12 at Night, and call the Hours after Midnight by 1, 2, 3, 4, *&c.* in the Morning, to 12 at Noon again the next Day. But to the Operation.

The *Globe*, &c. Rectified. Bring the place of the *Sun* to the number of Degrees of *Altitude*, accounted upon the *Quadrant of Altitude*, and the *Hour Index* ſhall point at the Hour in the *Hour-Circle*; yet herein reſpect muſt be had to the Fore or Afternoons *Elevation*; as ſhall be ſhewed in the nexe Probleme.

Example.

May 10. The *Sun* is elevated 40 Degrees above the *Horizon* here at *London*; therefore having found the place of the *Sun*, by the third Probleme, to be ♉ 29, I move the *Globe* and *Quadrant*, till I can join the 29th Degree of ♉ to the 40th Degree upon the *Quadrant of Altitude*; and then looking on the *Hour-Circle*, I find the *Index* point at 53 Minutes paſt 8 a Clock, for the Forenoon *Elevation*; and at 3 Hours 7 Minutes for the Afternoons *Elevation.* Therefore if it be Forenoon, I ſay it is 53 Minutes paſt 8 a Clock in the Morning. But if it be Afternoon, I ſay it is 7 Minutes paſt 3 a Clock in the Afternoon.

To find the Hour of the Day, if the *Sun* Shines.

This, the Right Honourable the Earl of *Caſtlemain* has hinted in § 1. *Oper.* 10. of his Book intituled, *The Engliſh Globe*: The manner is thus, Rectifie the *Globe* to correſpond in all reſpects with the Situation of the Sphere, as by *Prob.* 2. of this Book; ſo ſhall the ſhadow of the *Axis* (between the 10th of *March* and the 13th of *Sept.*) lye upon the Hour of the Day in the *Hour-Circle*. But to find the Hour the other half Year, you muſt, keeping the *Horizon* ſtill in its poſition, turn the *North-Pole* of the *Globe* till it be depreſſed under the *Horizon* on the *South* ſide, ſo many Degrees as before it was Elevated on the *North* ſide; ſo ſhall the *North-Pole* be directly oppoſite to its firſt Poſition, and ſhadow of the *Axis* lie on the Hour of the Day in the *Hour Circle*.

PROB. XIII.

How to know whether it be Before or After Noon.

HAving made one Obſervation, you muſt make a ſecond a little while after the firſt; and if the *Sun* increaſe in *Altitude*, it is before Noon; but if it decreaſe in Altitude, it is after Noon.

Example.

The *Sun* was at 8 Hor. 53 Min. *Elevated* 40 Degr. above the *Horizon*; a little while after (ſuppoſe for examples ſake a Quarter of an Hour) *viz.* at 9 Hor. 8. Min. I obſerve again the Height of the *Sun*, and find it 42 Degrees High; ſo that the *Altitude* is increaſed 2 Degrees therefore I ſay; it is Forenoon: But if the *Sun* had decreaſed in *Altitude*, I ſhould have ſaid, it is Afternoon.

How to take Altitudes *by the* Quadrant, Aſtrolabe, *and* Croſs-ſtaff.

There are divers Inſtruments whereby *Altitudes* may be taken; but the moſt in uſe are the *Quadrant*, *Aſtrolabe*, and *Croſs-ſtaff*. A *Quadrant* is an Inſtrument comprehended between two ſtraight lines making a right Angle, and an Arch deſcribed upon the Right Angle, as on the Center, containing 90 Degres, which is a quarter of a Circle; and therefore the Inſtrument is called a *Quadrant*. See this Figure.

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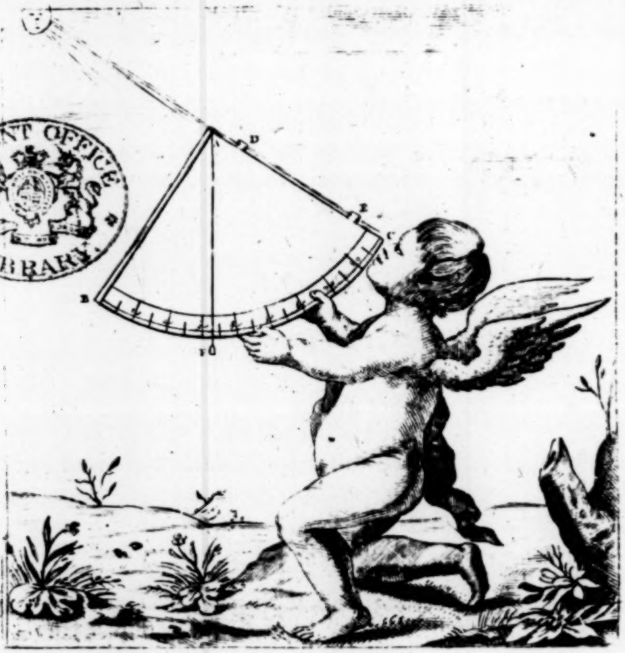
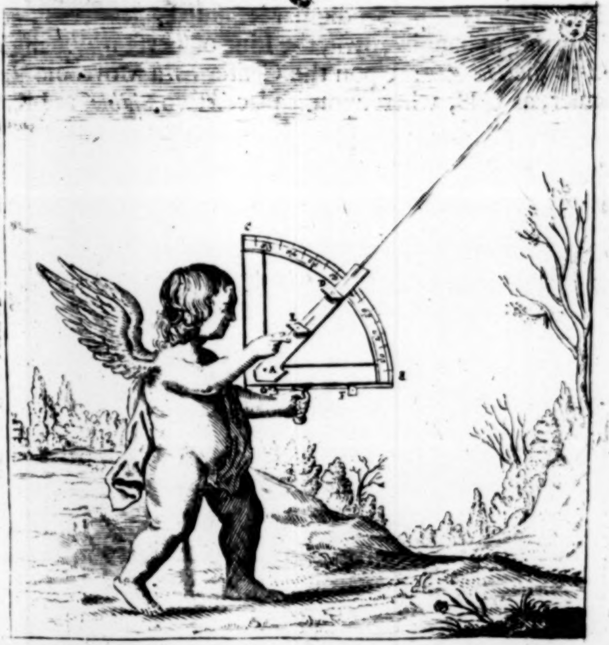


A repreſents the Center, upon which is faſtned a Plumb-line, A. B. the one ſide A.C. the other ſide, upon which the *Sights* are placed: B. C. the Arch or *Quadrant*, which is divided into 90 equal parts, and numbred from B. to C; D one *Sight* E the other *Sight*: F the *Plumbet* faſtned to the *Plumb-line*.

When by this Inſtrument you would Obſerve the Height of the *Sun*, you muſt turn the Center *A* to the *Sun*, and let Beams thereof dart in at the hole in the firſt *Sight* D, through the hole in the Second *Sight* E; ſo ſhall the *Plumb-line* lye upthe Degree in the *Limb* of the *Suns Elevation*: As if the *Plum-line* lie upon the 20th Degree, then ſhall the Altitude be 20 Degrees; if on 25 the *Altitude* ſhall be 25 Degrees; and for any number of Degrees the Thred or *Plumb-line* lies on, the ſame number of Degrees is the *Altitude* of the *Sun*.

But if it be a *Star* whoſe *Altitude* you would Obſerve; you muſt hold up the *Quadrant*, and joyn the *Limb* to your Cheek-bone, and turn the Center towards the *Star*; then winking with one Eye, look through the Holes of the *Sights* with the other Eye, till you can ſee the *Star* through thoſe Holes; ſo ſhall the *Plumb-line* (as before in the *Sun*) hang upon the Degree in the *Limb* of the *Stars Elevation.*

Another ſort of *Quadrant* is made with a moveable *Index*, as is repreſented in this Figure.

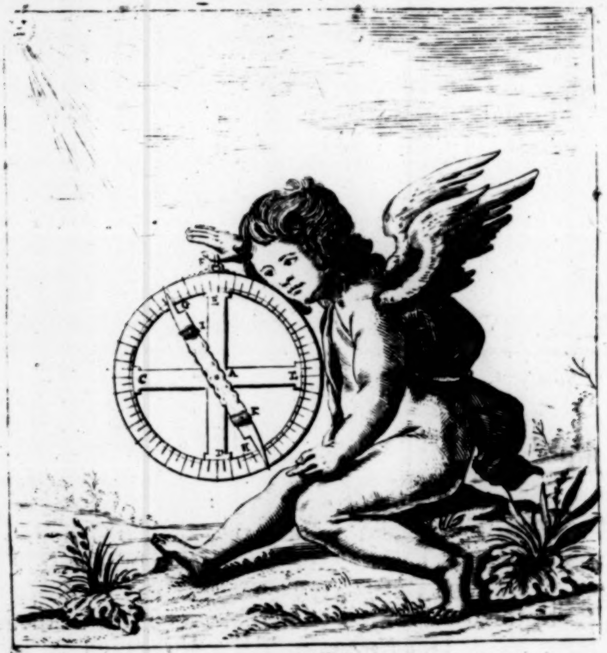


A is the *Center*, A B and A C the two ſides, B C the *Limb*, D E two *Sights* fixed upon a moveable *Index* or *Label*; F G two other *Sights* for Obſerving the *Horizon*.

When by this *Quadrant* you would obſerve an *Altitude*, the ſide B A muſt parallel to the *Horizon*, and the *Index* muſt be moved till the Object (be it either the *Sun*, *Moon* or any *Star*) be ſeen through the Holes or Slits of the *Sights* placed on the *Index*; for then the *Arch* DB ſhall be the *Elevation* required. You may know when the ſide B A is parallel to the *Horizon*, by Obſerving the parting of *Heaven* from the *Earth* through the *Sights* of the Side B A.

To take Altitudes *with the* Aſtrolabe.

The *Aſtrolabe* is a round Inſtrument flat on either ſide, upon one of the flats or plains is deſcribed a Circle, as BCDE, divided into 360 equal parts or Degrees, numbreed from the Line of Level B A C, with 10, 20, &c. to 90, in the perpendicular DC. Upon the perpendicular is faſtned a *Ring*, as F, ſo as the Inſtrument hanging by it, the Line of Level may hang parallel to the *Horizon*: Upon the Center is a Moveable *Label* or Ruler, as G H, whereupon is placed two *Sights*, as I K.



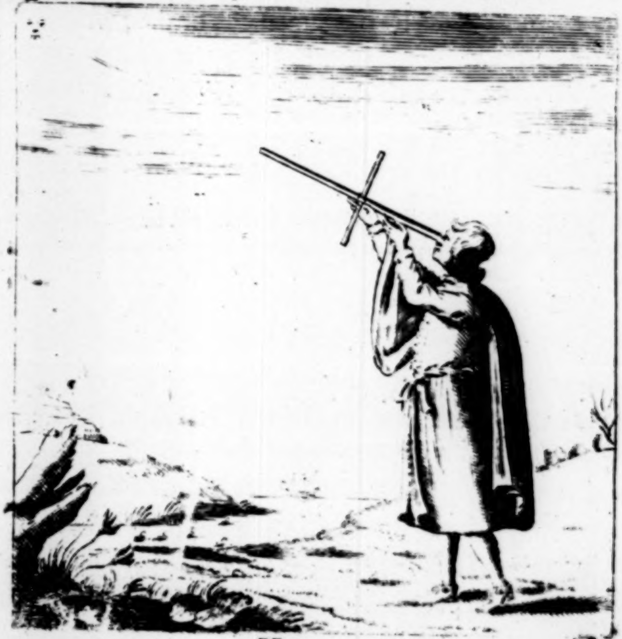
If you deſire further inſtructions for making this Inſtrument, you may peruſe Mr. *Wright* in his *Diviſion of the whole Art* *of Navigation*, annexed to his *Correction of Errors*; where he alſo ſhews the Uſe of it at large; which in brief is as follows.

You muſt hold the *Aſtrolabe* by the Ring in your left hand, and turning your right ſide to the *Sun*, lift up the *Label* with your right hand, till the Beams of the *Sun* entring through the Hole of the uppermoſt *Vane* or *Sight*; doth alſo pierce through the Hole in the nethermoſt *Vane* or *Sight*; and the Degree and part of Degree that the *Label* lies on is the height of the *Sun* above the *Horizon*.

But if it be a Star you would obſerve, you muſt uſe the *Aſtrolabe* as you were directed to uſe the *Quadrant*, holding it up to your Cheek-bone, and looking through the *Sights*,&c.

To take Altitudes *with the* Croſs-Staff.

This Inſtrument conſiſts of a *Staff* about a Yard long, and 3 quarters of an Inch ſquare: Upon it is fitted a *Vane* (or ſometime two or three) ſo as it may ſlide pretty ſtiff upon the *Staff*, and ſtand at any of the diviſions it is ſet to.



The making is taught by Mr. *Wright* aforeſaid: But the uſe is as follows.

You muſt put that end of the *Croſs-ſtaff* which is next 90 Degrees to your Cheek-bone, upon the outer corner of your Eye, and holding it there ſteddy, you muſt move the *Vane* till you ſee the *Horizon* joyned with the lower end thereof, and the *Sun* or *Star* with the higher end; then the Degree and part of Degree which the *Vane* cutteth upon the *Staff*, is the Height of the *Sun* or *Star*.

Some of theſe ways for taking *Altitudes* have been formerly taught by others that have treated upon the *Uſe of Globes*; and therefore becauſe ſome would be apt to think this Treatiſe uncompleat if I did not ſhew theſe ways alſo, I have thought fit to inſert them: Yet the ſame things may be performed by the *Globe* alone, without troubling your ſelf with multiplicity of Inſtruments, if your *Globe* be made with a hollow *Axis*; for then if the *Globe* ſtand *Horizontal*, you ſhall by Obſerving the Object through the *Axis*, have the Degree of *Elevation*, noted by the Superficies of the *Horizon*.

PROB. XIV.

To Obſerve with the Globe *the* Altitude *of the* Sun.

PLace the *Globe* ſo that the upper Plain of the *Horizon* may ſtand parallel to the Plain of the *Horizon* of your Place; as was taught by the Second Probleme; then turn the *North Pole* towards the *Sun*, and place it higher or lower, by moving the *Meridian* through the Notches of the *Horizon*, till the Beams of the *Sun* pierce quite through the *Axis* of the *Globe*: So ſhall the Arch of the *Meridian* comprehended between the *Pole* and the edge of the *Horizon*, be the number of Degrees that the *Sun* is elevated above the *Horizon*.

Example.

March 20. juſt at Noon, here at *London*, I would Obſerve the *Meridian Altitude* of the *Sun*. Therefore placing the *Horizon* Horizontal, as by the Second Probleme: I turn the *North*

Pole towards the *Sun*, and move it with the *Meridian* upwards or downwards, either to this ſide or that, till I can fit it to ſuch a poſition that the *Sun*-Beams may dart quite through the hollow *Axis* of the *Globe*; which when it does, I look on the *Meridian*, and find 42 Degrees 25 Min. comprehended between the *Pole* and the Superficies of the *Horizon*: Therefore I ſay the *Meridian Altitude* of the *Sun*, *March* 20. here at *London* is 42 Degrees 25 Min.

PROB. XV.

To find the Elevation *of the* Pole, *by the* Meridian Altitude *of the* Sun, *and Day of the Month given.*

THE Day of the Month is *March* 20. By the 4th Prob. you may find the place of the *Sun* to be ♈ 10. Therefore bring the place of the *Sun* to the *Meridian*, and Elevate it above the *Horizon*, the ſame number of Degrees it hath in Heaven; ſo ſhall the Arch of the *Meridian* comprehended between the *Pole* and the *Horizon*, be the Elevation of the *Pole* in your Place.

Otherwiſe.

The Day of the Month given is *March* 20. ſo that by the 4th Prob. you have the *Suns* place ♈ 10; and by the fifth, the *Declination* of the *Sun* 3, 55. *North*; therefore the *Declination* being *North*, and you on the *North* ſide the *Equator*; you muſt ſubtract 3. 55. from the *Meridian Altitude* 42. 25. and there remains 38. 30. for the Height of the *Equinoctial* above the *Horizon*: But if your *Declination* had been *South*, you muſt have added 3. 55. to the *Meridian Altitude*, and the Sum would have been the Elevation of the *Equinoctial*. Having the Elevation of the *Equinoctial*, you may eaſily have the Elevation of the *Pole*; for the one is always the Complement of the other to 90. Thus the Height of the *Equinoctial* 38. 30. ſubtracted from 90, leaves 51. 30. for the Elevation of the *Pole*, here at *London*. And thus it follows, That the *Latitude* of any place from the *Equinoctial*, is always equal to the Elevation of the *Pole*; for between the *Zenith* and the *Equinoctial* is contained the Complement of the Heighth of the *Equinoctial* above the *Horizon* to 90.

PROB. XVI.

To take the Altitude *of any* Star *above the* Horizon, *by the Globe.*

THe *Horizon* of the *Globe* ſet parallel to the *Horizon* of the *World*, as before: Turn the *North Pole* towards the *Star*, and when you can ſee the *Star* through the *Axis*, the *Northern* Notch of the *Horizon* will cut the Degree of *Elevation* on the *Meridian*.

Example.

April 19. at 11 a Clock at Night, I would Obſerve the *Altitude* of *Spica Virgo*. Therefore I ſet the *Horizon* parallel to the *Horizon* of the *World*, as by the Second Probleme, and turn the *Northern Pole* till it point towards the *Star*: Then looking in at the *South Pole* of the *Globe* through the *Axis*, I ſhall ſee the *Star*, and have on the *Meridian* the Queſtion reſolved. But if it point not axactly, then I move the *North Pole* either upwards or downwards to the right or to the left Hand, according as I may find occaſion, till I can ſee the *Star* through the *Axis*; and then the edge of the Notch in the *Horizon* cuts 28 Degrees 59 Min. on the *Brazen Meridian*. Therefore I ſay *April* 19. at 11 a Clock at Night, here at *London*, the *Altitude* of *Spica* ♍ is 28 Degr. 59 Min. above the *Horizon*.

PROB. XVII.

By the Meridian Altitude *of any* Star *given, to find the Heighth of the* Pole.

JOyn the *Star* to the *Meridian*, and place it to the *Altitude* Obſerved; ſo ſhall the number of Degrees intercepted between the *Pole* and the *Horizon*, be the Elevation of the *Pole*.

Example.

Example.

Spica Virgo is obſerved to have 28 Degr. 59 Min. *Meridian Altitude*; therefore I bring *Spica Virgo* to the *Meridian*, and Raiſe it or Depreſs it higher or lower as I find occaſion, till it is juſt 28 Degr. 59 Min. above the *Horizon*: Then I count number of Degrees between the *Pole* and the *Horizon*, and find them 51½. Therefore I ſay the Elevation of the *Pole* is here at *London* 51½. Yet note, If the *Star*, whoſe *Altitude* you Obſerve, have fewer number of Degrees of *Declination* from the *Pole* than the Elevation of the *Pole*, you may be apt to miſtake in its coming to the *Meridian*; for thoſe *Stars* never ſet; and therefore are twice viſible in the *Meridian* in 24 Hours; once above the *Pole*, and once under the *Pole*.

If your *Star* have greater *Altitude* than the *North Star*, it is Above the *Pole*: but if it have leſs, it is below the *Pole*; ſo that if you know but whether it be Above or Below, it is enough; for ſo you may accordingly Raiſe it to the *Altitude* on the *Meridian* it hath *Heaven*, and joyn it to the *Meridian* either Above or Beneath the *Pole*, as the *Star* is placed in *Heaven*: and then the Arch of the *Meridian* comprehended between the *Pole* and the *Horizon*, is the *Elevation* of the *Pole*, as aforeſaid.

Otherwiſe.

Having the *Meridian Altitude* of the *Star*, you muſt find its *Declination* by the 27 Probleme; and if the *Declination* be *South*, and you on the *North* ſide the *Equator*, you muſt add the *Declination* to the *Meridian Altitude*, and the Sum of both makes the *Altitude* of the *Equinoctial*: But if the *Declination* be *North*, and you on the *North* ſide the *Equator*, you muſt Subtract the *Declination* from the *Meridian Altitude*, (as was taught by the 15 Prob. in the *Example* of the *Sun*) and the Remainder is the *Altitude* of the *Equinoctiul*. Then (as was taught by the 15 Prob. aforeſaid) Subtract the *Altitude* of the *Equinoctial* from 90. The Remainder is the *Elevation* of the *Pole* in your Place.

Example.

Example.

By the laſt Probleme the *Meridian Altitude* of *Spica Virgo* was 28 Degrees 5 Minutes and the *Declination* of *Spica* by the 27th Probleme is found 9 Degrees 3 Min. *South*: Therefore becauſe the *Declination* is *South*, I add 9 Degrees 3 Min. to the *Meridian Altitude*, which makes 38 Degrees 30 Min. for the *Elevation* of the *Equinoctial*; which 38 Degrees 30Min. Subtracted from 90, leaves 51 Deg. 30 Min. for the *Elevation* of the *Pole* here at *London*.

PROB. XVIII.

Another way to find the Height of the Pole *by the* Globe; *if the place of the* Sun *be given: And alſo to find the Hour of the Day and* Azimuth, *and* Almicanter *of the* Sun.

THis muſt be performed by help of a *Spherick Gnomon*; which is a ſmall Pin or *Needle* fixed perpendicularly into a ſmall *Baſis* with an Hollow concave Bottom, that it may ſtand upon the convexity of the *Globe*. Therefore the *Horizon* of the *Globe* being ſet parallel to the *Horizon* of the *World* (as by the ſecond Probleme) the *Spherick Gnomon* muſt be ſet exactly upon the place of the *Sun*; and then turning the *Globe* about (upon its *Axis* either from *Eaſt* to *Weſt*, or contrarily from *Weſt* to *Eaſt*; or elſe by the *Meridian* through the Notches of the *Horizon*) till the *Spherick Gnomon* caſt no Shadow on any ſide thereof, you have on the *Meridian* in the *North* point of the *Horizon* the number of Degrees that the *Pole* is elevated above the *Horizon*.

Example.

Imagine the four Quarters of the *Horizon* of the *Globe* correſpond with the four Quarters of the *Horizon* of the *World*; and the plain of the *Horizon* of the *Globe* is parallel to the plain of the *Horizon* of the *World*: The *Suns* place is ♉ 29, which I find on the *Globe*, and place the *Spherick Gnomen* thereon; then at a gueſs I move the *Globe* both on its *Axis*, and by the *Meridian* (as near as I can) ſo as the *Spherick Gnomen* may caſt no Shadow; yet if it do, and the Shadow fall towards the *North Pole*; then I Elevate the *North Pole* more till the Shadow falls juſt in the middle of its ſelf; but if the Shadow fall downwards towards the *South Pole*, then I Depreſs the *North Pole*: If the Shadow fall on the *Eaſt* ſide, I turn the *Globe* on its *Axis* more to the *Weſt*; and if the Shadow fall to the *Weſt*, I turn the *Globe* more into the *Eaſt*; and the Degree of the *Meridian* which the *North* Point of the *Horizon* touches, is the Degree of the *Poles* Elevation: which in this Example is 51½ the *Latitude* of the City of *London*.

By this Operation you have alſo given the Hour of the Day in the Hour-Circle, if you keep the *Globe* unmoved; and the *Azimuth*, and *Almicantar*, if you apply but the *Quadrant of Altitude* to the place of the *Sun*, as by the 22 and 23 Problemes.

PROB. XIX.

To Obſerve by the Globe *the Diſtance of two* Stars.

YOu muſt pitch upon two *Stars* in the *Meridian*, and Obſerve the *Altitude* of one of them firſt, and afterwards the Altitude of the other; then Subtract the Leſſer *Altitude* from the Greater, and the Remainder ſhall be the Diſtance required.

Example.

March 7. at 11 a Clock at Night here at *London*, I ſee in the *Meridian* the two *Stars* in the Foremoſt *Wheels* of the *VVaggon*, in the *Conſtellation* of the *Great Bear*, called by the Sea-men *Pointers*, (becauſe, they always point towards the *Pole-ſtar*) Therefore to Obſerve the Diſtance between theſe two *Stars*, I firſt Obſerve (as by the laſt Probleme) the *Altitude* of the moſt *Northern* to be 77 Degrees 59 Minutes, and ſet down that Number of Degrees and Minutes with a Pen and Ink on a Paper, or with a piece of Chalk, or a Pencil, on a Board; and afterwards I Obſerve the *Altitude* of the other *Star* which is under it, as I did the firſt, to be 83 Degrees 21 Min. and ſet that number of Degrees and Minutes alſo down, under the other number of Degrees and Minutes: Then by Subtracting the Leſſer from the greater, I find the Remainder to be 5 Degrees 22 Min. which is the Diſtance of the two *Stars* in the *Great Bear*, called the *Pointers*.

PROB. XX.

How you may learn to give a Gueſs at the number of Degrees that any two Stars *are diſtant from one another; or the number of Degrees of* Altitude *the* Sun, *or any* Star, *is Elevated above the* Horizon; *only by looking up to* Heaven *without any Inſtrument.*

BEtween the *Zenith* and *Horizon* is comprehended an Arch of a Circle containing 90 Degrees; ſo that if you ſee any *Star* in or near the *Zenith*, you may know that *Star* is 90, or near 90 Degrees High; and by ſo much as you may conceive it wants of the *Zenith*, ſo much you may gueſs it wants of 90 Degrees above the *Horizon*. But this Rule you may Gueſs at an Arch of *Heaven* containing 90 Degrees, or at an Arch of *Heaven* containing 45 Degrees if by your Imagination you divide the whole Arch into two equal parts, for then ſhall each of them contain 45 Degrees; And if by your Imagination you divide the whole Arch of 90 into 3 equal parts, each Diviſion ſhall contain an Arch of 90 Degrees, &c. But this way is a little too rude for Gueſſing at Stars Elevated but few Degrees, or for *Stars*, Diſtant but few Degrees from one another. Therefore that you may learn to gueſs more preciſely at Diſtances in *Heaven*, you may either with a *Quadrant*, *Aſtrolabe*, or the *Globe*, find the exact Diſtance of any two known *Stars* that are but few Degrees a ſunder, and by a little revolving the Diſtance of thoſe *Stars* in your fancy, you may at length ſo imprint their Diſtance in your Memory, that you may readily gueſs the Diſtance of other *Stars* by the Diſtance of them.

Example.

You may find either by the *Globe*, *Quadrant*, or *Aſtrolabe* (for they all agree) 3 Degrees comprehended between the firſt *Star* in *Orion's Girdle*, and the Laſt; therefore by a little conſidering that Diſtance, you may imprint it in your Fancy for 3 Degrees, and ſo make it applicable to other *Stars*, either of the ſame Diſtance or more, or leſs: And the *Pointers* (by the laſt Probleme) are Diſtant from one another 5 Degrees, and almoſt an half: Theſe are always above our *Horizon*, and therefore may always ſtand as a Scale for 5 and a half Degrees; ſo that by theſe for 5½ Degrees, and thoſe in *Orions Girdle* for three Degrees, and others Obſerved, either of Greater or Leſſer diſtance, you may according to your own Judgment ſhape a Gueſs, if not exactly, yet pretty near Truth, when you come to other *Stars*. Thus you may exerciſe your Fancy upon *Stars* found to be 10 or 15 Degrees aſunder, or more or leſs; and with a few Experiments of this Nature enure your Judgment to Gueſs at Diſtances, and enable your Memory to retain thoſe Gueſſes.

This way of Gueſſing will be exact enough for finding the Hour of the Night by the *Stars*, for moſt common Uſes; or the Hour of the Day, by Gueſſing at the *Altitude* of the *Sun*; if after you have Gueſſed at the *Altitude*, you work as was taught by Prob. 12. for the Hour of the Day; and as ſhall be taught in the next Problem for the Hour of the Night.

PROB. XXI.

The Day of the Month and Altitude *of any* Star *given; to find the Hour of the Night.*

THe *Globe*, *Quadrant*, and *Hour-Index* Rectified; bring the *Star* on the *Globe* to the ſame number of Degrees on the *Quadrant of Altitude* that it hath in *Heaven*: So ſhall the *Index* of the *Hour-Circle* point in the *Hour-Circle* at the Hour of the Night,

Example.

March 10. The *Altitude* of *Arcturus* is 35 Degrees above the *Horizon* here at *London*: Therefore having the *Globe*, *Quadrant*, and *Hour- Index* Rectified, I bring *Arcturus* on the *Globe* to 35 Degrees on the *Quadrant of Altitude*: and then looking in the *Hour-Circle*, I find the *Index* point at 10 a Clock, which is the Hour of the Night.

PROB. XXII.

The place of the Sun, *and Hour of the* Day *given*; *to find its* Azimuth *in any aſſigned* Latitude.

THe *Globe*, &c. Rectified to your *Latitude*; Turn the *Globe* till the *Index* of the *Hour-Circle* come to the Given Hour; and bring the *Quadrant of Altitude* to the place of the *Sun*; ſo ſhall the number of Degrees contained between the *Eaſt* or *Weſt* point of the *Horizon*, and the Degree cut by the *Quadrant of Altitude* on the *Horizon*, be the number of Degrees of the *Suns Azimuth*, at that Time.

Example.

May 10. at 53 Minutes paſt 8 a Clock in the Morning, I would know the *Azimuth* of the *Sun*: Therefore (the *Globe* being firſt Rectified) I turn about the *Globe* till the *Index* of the *Hour-Circle* point to 53 Minutes paſt 8 a Clock, or which is all one, within Half a quarter of an Hour of 9; then I move the *Quadrant of Altitude*, to the Degree the *Sun* is in that Day, and there let it remain, till I ſee how many Degrees is contained between the *Eaſt* point, and the *Quadrant of Altitude*, which in this *Example* is 28 Deg. 25 Min. for the *Azimuthal* diſtance of the *Sun* from the *Eaſt* point towards the *North*.

PROB.

PROB. XXIII.

The place of the Sun *and Hour of the Day given, to find the* Almicantar *of the* Sun.

THe finding the *Almicantar* of the *Sun* is upon the matter the ſame with the *Altitude* of the *Sun*; only with this diſtinction, The *Almicantars* are Circles parallel to the *Horizon* deſcribed by the Degree of the *Quadrant of Altitude* upon the *Zenith* as its Center, by turning the *Quadrant* round about the *Globe* till it come again to its firſt place: But the *Altitude* is an Arch of the *Quadrant of Altitude* or *Vertical Circle*, comprehended between the *Horizon* and any point of the *Globe* aſſigned. Their Agreement conſiſts in this; When the *Sun* or any *Star* hath any known *Almicantar*, they are ſaid to have the ſame number of Degrees of *Altitude*; as if the *Sun* be in the 20 *Almicantar*, he hath 20 Degrees of *Altitude*; if in the 30th *Almicantar*, he hath 30 Degrees of *Altitude*, &c. Now becauſe the Operation is the ſame for finding the *Altitude* and *Almicantar*, I ſhall refer you to the 11 Probleme; which ſhews you how to find the *Altitude* or *Height*; and by conſequence the *Almicantar*.

PROB. XXIV.

The place of the Sun *given, to find what Hour it comes to the* Eaſt *or* Weſt; *and what* Almicantar *it then ſhall have.*

THe *Globe*, *Quadrant*, and *Hour-Index* Rectified: Bring the *Quadrant of Altitude* to the *Eaſt* point in the *Horizon*, if you would know what Hour it comes to the *Eaſt*, or to the *Weſt* point, if you would know what Hour it comes to the *Weſt*: Then turn about the *Globe* till the place of the *Sun* come to the *Quadrant of Altitude*; and the *Index* of the *Hour-Circle* ſhall point at the Hour of the Day; which on the Day aforeſaid will be 7 Hor. 7. Min. in the Morning that the *Sun* cometh to the *Eaſt*, and 4 Hor. 53 Min. after Noon that the *Sun* cometh to the *Weſt*. And if you then count the number of Degrees from the *Horizon* upwards on the *Quadrant of Altitude*, it will ſhew you the *Almicantar* of the *Sun* for that Time; which will both Morning and Evening be 25 Deg. 30 Min. as was taught by the laſt Probleme.

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PROB. XXV.

To know at any time what a Clock it is in any other Part of the Earth.

THe difference of *Time* is reckoned by the acceſs and progreſs of the *Sun*; for the *Sun* gradually circumvolving the *Earth* in 24 Hours, doth by reaſon of the *Earths* rotundity enlighten but Half of it at the ſame moment of *Time*; as ſhall be ſhewed hereafter; ſo that hereby it comes to paſs, that when with us here in *England* it is 6 a Clock in the Morning, with thoſe that have 90 Degrees of *Longitude* to the *Weſtward* of Us, it is yet Midnight; with thoſe that have 180 Degrees of *Longitude* from Us, it is Evening; and with thoſe that have 90 Degrees of *Longitude* to the *Eaſtwards*, it is Noon. So that thoſe to the *Eaſtward* have their Day begin ſooner than Ours: But to the *Weſtward* their day begins after Ours. Therefore that you may know what Hour it is in any Place of the *Earth*, of what Diſtance ſoever it be, you muſt firſt bring the Place of your own Habitation to the *Meridian*, and the *Index* of the *Hour Circle* to 12 on the *Hour-Circle*; Then bring the other Place to the *Meridian*, and the Arch of the *Hour-Circle* comprehended between the Hour 12 and the *Index*, is the difference in *Time* between the two Places.

Example.

London in *England*, and *Surate* in the *Eaſt-Indies*: Firſt I bring *London* to the *Meridian*, and turn the *Index* of the *Hour-Circle to* 12; then I turn the *Globe Weſtward*, becauſe *London* is *VVeſtward* of *Surat*, till *Surat* come to the *Meridian*; and ſee at what Hour the *Index* of the *Hour-Circle* points, which in this *Example* is 5 Hor. 54 Minutes: And becauſe *Surat* lies to the *Eaſtwards* of Us ſo many Degrees, therefore, as was ſaid before, their Day begins ſo much before Ours: So that when here at *London* it is 6 a Clock in the Morning, at *Surat* it will be 11. a Clock 54 Minutes; when with Us it is 12 a Clock, with them it will be 5 a Clock 54 Minutes after Noon.

If you would know the difference of *Time* between *London* and *Jamaica*,; Working as before, you may find 5 Hor. 15 Min. but *Jamaica*, is to the *Weſt* of *London*; therefore Their Day begins 5 Hor. 15 Min. after Ours; ſo that when with Us it is Noon, with Them it will be but Three quarters of an Hour paſt 6 a Clock in the Morning; and when with them it is Noon, with Us it will be One quarter paſt 5 a Clock after Noon, &c.

Or you may yet otherwiſe know the difference of *Time*, if you divide the number of Degrees of the *Equinoctial* that paſs through the *Meridian* while the *Globe* is moved from the Firſt place to the Second,by 15. ſo ſhall the Product give you the difference of Hours and Minutes between the two Places; as you will find, if you Try either of theſe Examples,or any other.

PROB. XXVI.

To find the Right Aſcenſion *of the* Sun, *or* Stars.

THe *Right Aſcenſion* of any point on the *Globe* is found by bringing the point propoſed to the *Meridian*, and counting in the *Equinoctial* the number of Degrees comprehended between the *Vernal Colour* and the Meridian.

Example, for the *Sun*.

June 1. I would know the *Right Aſcenſion* of the *Sun*: His place (found as by the third *Probleme*) is *Gemini* 20. Therefore I bring *Gemini* 20 to the *Meridian*; and then the *Meridian* cuts the *Equinoctial* in 79 Deg. 15 Min. accounted from the *Vernal* point *Aries*: Therefore I ſay the *Right Aſcenſion* of the *Sun June* 1. is 79 Deg. 15 Min.

Example, for a *Star*.

I take *Capella*, alias *Hircus*, the *Goat* on *Auriga*'s Shoulder, and bring it to the *Meridian*; and find the *Meridian* cut the *Equinoctial* (counting as before from the *Vernal* point ♈) in 73 Degrees 58 Minutes: Therefore I ſay the *Right Aſcention* of *Hircus* is 73 Degrees 58 Minutes. Do the like for any other point of the *Globe* propoſed.

PROB. XXVII.

To find the Declination *of the* Sun *and* Stars.

THe *Declination* of any point on the *Globe* is found by bringing the point propoſed to the *Meridian*, and counting the number of Degrees comprehended on the *Meridian* between the *Equinoctial* and the point propoſed; and bears its Denomination of *North* or *South*, according as it is Situate on the *North* or *South* ſide the *Equinoctial*.

Example, for the *Sun*.

June 1. I would know the *Declination* of the *Sun*. His place found as before, is *Gemini* 20. Therefore I bring ♊ 20, to the *Meridian*, and find 23 Degrees 8 Minutes comprehended on the *Meridian* between the *Equinoctial* and ♊ 20. and becauſe *Gemini* is on the *North* ſide the *Equinoctial*; therefore I ſay *June* 1. the *Sun* hath *North Declination* 23 Degrees 8 Minutes.

Example, for a *Star*.

I take *Hircus* aforeſaid, and bring it to the *Meridian*, and find 45 Degrees 40 Minutes comprehended on the *Meridian* between the *Equinoctial* and the *Star Hircus*. And becauſe *Hircus* is on the *North* ſide the *Equinoctial*; Therefore I ſay, *Hircus* hath *North Declination* 45 Degrees 40 Minutes. Do the like for any other point on the *Globe* propoſed.

But note: The *Right Aſcention* and Declination of the *Sun* alters Daily; for in 12 Months he runs through every Degree of *Right Aſcention*, and in three Months to his greateſt *Declination*: But the *Right Aſcention* and *Declination* of the *Stars* is ſcarce perceivable for ſome Years: Yet have they alſo an alteration of *Right Aſcention* and *Declination*: For, thoſe *Stars* that have but few Degrees of *Right Aſcenſion*, will in proceſs of *Time* have many, and thoſe *Stars* between the *Tropick* and *Equinoctial* that have *North Declination* will in length of *Time* have *South Declination*; and the contrary,(as ſhall be more fully ſhewed hereafter:) For, the *Stars* moving upon the *Poles* of the *Ecliptick*, go forwards in *Longitude* one whole Degree in 70½ Years (as hath been ſhewed before *Book* 1 *Chap*. 3. *Sect*. 3.) and ſo alter both their *Right Aſcention* and *Declination*; as may be ſeen by this following Table of *Right Aſcentions* and *Declinations* of 100 of the moſt eminent fixed *Stars*; Calculated by *Tycho Brahe*, for the Years 1600 and 1700, which I have inſerted; partly,becauſe by it you may ſee the Difference of their *Right Aſcenſions* and *Declinations* in 70½ Years; and partly to accommodate thoſe that may have occaſion to know their *Right Aſcenſions* and *Declinations* nearer than the *Globe* can ſhew them.

A Table of the *Right Aſcenſions* and *Declinations* of 100 Select Fixed *Stars*; Calculated by *Tycho Brahe*, for the Years 1600 and 1700. As alſo their Difference of *Right Aſcenſions* and *Declinations* in 70 Years.

	1600.					Differentia.			1670.			
Names of the Stars.	*R. Aſc.*		*Declin.*			*R. A.*		*Decl.*	*R. Aſc.*		*Declin.*	
Scedir, *in* Calliopeæ.	4	36	54	21	N	1	22	34 S	5	58	54	55
The Pole *Star*. (tail.	5	47	87	9½	N	3	59	34 S	9	46	87	43½
Southern in the Whales-	5	51	20	12	S	1	17	34 N	7	8	19	38
Caſſiopeæ's Belly.	8	21	58	33	N	1	27	34 S	9	48	59	7
Girdle Andromeda.	11	50	33	32	N	1	23	33 S	13	13	34	5
Knee *of Caſſiopeæ*.	15	3	58	7	N	1	35	33 S	16	38	58	40
1. in ♈ Horn.	22	56	17	19	N	1	23	33 S	24	19	17	50
VVhales Belly.	22	59	12	16	S	1	15	31 N	24	14	11	45
2. *in* ♈ Horn.	23	10	18	50	N	1	22	31 S	24	32	19	01
South Foot of Andromeda.	24	55	40	23	N	1	29	30 S	26	24	40	52

	1600.			Differentia.		1700.	
Names of the Stars.	R. Aſc.	Declin.		R. A.	Decl.	R. Aſc.	Declin.
In the Knot *in the line* ♓.	25 22	0 50	N	1 18	30 S	26 40	1 20
* *Star in* ♈ *Head.*	26 23	21 33	N	1 25	30 S	27 38	22 3
* *In the VVhales* Jaw.	40 25	2 29	N	1 15	25 S	41 40	2 54
Caput Meduſæ.	40 38	39 22	N	1 37	25 S	42 15	39 47
* *In Perſeus* Side.	44 2	43 22	N	1 28	21 S	45 30	48 43
* *In the* Pleiades.	50 57	22 49	N	1 29	21 S	52 26	23 10
In the Noſtrils *of* ♉.	59 10	14 37	N	1 25	17 S	60 41	14 54
North Eye *of* ♉	61 21	18 14	N	1 24	17 S	62 45	18 31
Aldebaran.	63 16½	15 38	N	1 26½	15 S	64 43	15 53
Hircus, Capella.	71 49	45 30	N	1 49	10 S	73 38	45 40
* *Orions Foot*, Rigel.	73 51½	8 43	S	1 15½	9½ S	75 7	8 33½
North Horn ♉.	75 16	28 12	N	1 37	8 S	76 53	28 20
Orions left Shoulder.	75 58	5 55	N	1 19	8 S	77 17	6 3
Belly *of the Hare.*	77 48	21 6	S	1 5	7 N	78 53	20 59
1. *In Orions* Girdle.	77 58	0 39	S	1 17	7 N	79 15	0 32
Uppermoſt in Orions Face.	78 21	2 36	N	1 22	7 S	79 41	0 43
South Horn ♉.	78 26	20 51	N	1 31	7 S	79 57	20 58
2. *In Orions* Girdle.	79 1	1 30	S	1 17	6 N	80 18	1 24
Laſt in Orions Girdle.	80 10	2 12	S	1 16	5 N	81 26	2 7
Auriga's right Shoulder.	82 40	44 50	N	1 55	4 S	84 35	44 54
Orion's right Shoulder.	83 26	7 16	N	1 22	4 S	84 48	7 20
* *Foot* ♊.	93 38	16 40	N	1 28	2 N	95 6	16 38
Great Dog, Sirius. (*Twin.*	96 53	16 11	S	1 7	4 S	98 0	16 15
Head *of Caſtor, the firſt.*	107 9	32 41	N	1 44	11 N	108 53	32 30
The little Dog, Procyon.	109 37	5 12	N	1 20	12 N	110 57	6 0
Head *Pollux, ſecond Twin.*	110 13	28 55	N	1 34	12 N	111 47	28 43
* *In the* Stern *of the Ship*	117 39	23 11	S	1 4	15 S	118 43	23 26
Præſepe ♋.	124 20	21 2	N	1 28	19 N	125 48	20 43
Northern Aſs ♋.	124 58	22 51	N	1 30	20 N	126 28	22 31
Southern Aſs ♋.	125 27	19 35	N	1 27	20 N	126 54	19 15
The Heart *of Hydra.*	137 1	6 57	S	1 15	25 S	138 16	7 22
South of 3. *in* Neck ♌.	146 22	18 42	N	1 28	28 N	147 50	18 14
Lyons Heart, Baſiliſcus.	146 45½	13 53½	N	1 53½	28½ N	148 8	13 25
North of 3. *in* Neck ♌.	148 33	25 23	N	1 23	29 N	150 1	24 54
Middle of 3. *in* Neck ♌.	149 25½	21 50	N	1 50	29 N	150 51	21 21

Names

	1600.					Differentia.				1670.			
Names of the Stars.	R. Aſc.		Declin.			R. A.		Decl.		R. Aſc.		Declin.	
Firſt loweſt in □ *Urſa Maj.*	159	12	58	31	N	1	37	32	N	160	49	57	59
Firſt upper in □ Dubbe.	159	37	63	54	N	1	41	32	N	161	18	63	22
* Back ♌.	163	10	22	43	N	1	27	34	N	164	37	22	9
Lions Tail.	172	9	16	49	N	1	19	34	N	173	28	16	15
Following loweſt in □ *Urſa (Major.*	173	3	55	57	N	1	23	34	N	174	26	55	23
Uppermoſt following in □.	178	50	59	15	N	1	20	34	N	180	10	58	41
Girdle ♍.	188	53	5	37	N	1	18	34	N	190	11	5	3
Rump *Urſa Major*, Aliot.	189	1	58	10	N	1	19	33	N	190	10	57	37
Vindemiatrix, ♍.	190	36	13	8	N	1	17	33	N	191	53	12	35
Spica ♍.	196	4	9	1	S	1	19½	32½	S	197	23½	9	31
Middle Tail *Urſa Major.*	196	54	57	3	N	1	3	32	N	197	57	56	31
End Tail *Urſa Major.*	202	54	51	22	N	1	2	31	N	203	56	50	51
Arcturus.	209	23½	21	18½	N	1	11	29½	N	210	34½	20	49
Left Shoulder *of Bootes.*	214	2	40	3	N	1	2	27	N	215	4	39	36
South Scale ♎.	217	14½	14	18	S	1	23	27	S	218	37½	14	45
North Scale ♎.	223	54½	7	50	S	1	21½	24	S	225	16	8	14
* *Northern Crown.*	229	26	28	6	N	1	5	21	N	230	31	27	45
* *Serpents* Neck.	231	12	7	46	N	1	15	21	N	232	27	7	25
*North. of 3 * in* Front ♏.	235	34	18	38	S	1	28	19	S	237	2	18	57
Left Hand *Ophiucus.*	238	25	2	37	S	1	23	18	S	239	48	2	55
Heart ♏. Antares.	241	18	25	26	S	1	32	16	S	242	50	25	42
Right Shoulder *Hercules.*	243	15	22	27	N	1	5	15	N	244	20	22	12
Left Knee *of Ophiucus.*	243	49	9	39	S	1	23	15	S	245	12	9	54
Right Knee *of Ophiucus.*	251	50	15	7	S	0	50	10	S	252	40	15	17
Head *of Hercules.*	254	6	14	55	N	1	8	8	N	255	14	14	47
Left Shoulder *of* Hercul.	254	40	25	22	N	0	52	8	N	255	32	25	14
Head *of Ophiucus.*	259	5	12	56	N	1	11	7	N	260	16	12	49
Right Shoulder *Ophiucus*	260	56	4	49	N	1	13	5	N	262	9	4	44
* Head *of the Dragon.*	266	52	51	37	N	0	35	2	N	267	27	51	35
* Lyræ.	275	52	38	28	N	0	50	4	S	276	42	38	32
Moſt Eaſtern in Head ♐.	281	32	21	35	N	1	31	8	N	283	3	21	27
Vultures Tail.	281	47	13	20	S	1	13	8	S	283	0	13	28
In the Swans Beak.	288	40	27	10	N	1	1	11	S	289	41	27	21
* *in Vulture.*	292	49	7	54	N	1	17	13	S	294	6	8	7
In the Swans North Wing.	293	10	44	12	N	0	48	14	N	293	58	44	26

	1600.			Differentia.		1670.	
Names of the Stars.	*R. Aſc.*	*Declin.*		*R. A.*	*Decl.*	*R. Aſc.*	*Declin.*
Upper Horn ♑.	289 57	13 40	S	1 25	16 N	300 22	13 24
Lower Horn ♑.	299 39	15 57	S	1 27	17 N	301 6	15 40
In the Swans Breaſt.	302 1½	39 1	N	0 53½	18 S	302 55	39 19
Left Hand *of* ♒.	306 32	10 53	S	1 16	19 N	307 48	10 34
Swans Tail.	306 57½	43 53½	N	0 51½	20½ S	307 49	44 14
In the Swans South Wing.	307 31	32 30	N	1 0	21 S	308 31	32 51
Left Shoulder ♒.	317 37	7 15	S	1 21	26 N	318 58	6 49
1. *In* Tail ♑.	319 28	18 21	S	1 26	26 N	320 54	17 55
In Cepheus Girdle.	320 46	68 50	N	0 22	26 S	321 8	69 16
In Pegaſus Mouth.	321 10	8 5	N	1 18	26 S	322 28	8 31
2. *In* Tail ♑.	321 16	17 51	S	1 25	27 N	322 41	17 24
Right Shoulder of ♒.	326 19	2 13	S	1 20	29 N	327 39	1 44
Fomahant, ♒.	338 46	31 39	S	1 25	31 N	340 11	31 8
Scheat, *Pegaſus.*	241 9	25 56	N	1 12	32 S	342 11	26 28
Marchab, *Pegaſus.*	341 15	13 5	N	1 15	32 S	342 30	13 37
Mouth *of Southern* Fiſh.	344 9	1 7	N	1 17	33 S	345 26	1 40
Head of Andromeda.	356 59	26 54	N	1 17	34 S	358 16	27 28
* *Caſſiopeæ's* Chair.	357 5	56 58	N	1 15	34 S	358 20	57 32
End of Pegaſus Wing.	358 14	12 58	N	1 16	34 S	359 30	13 32
Northern the VVhales Tail	359 49	11 1	S	1 18	34 S	1 7	10 27

Of the Uſe of this Table.

The Firſt Column on the left Hand is the Names of the *Stars.* The Second Column ſhews the Degrees and Minutes of *Right Aſcenſion* for the Year 1600. The Third the *Declination* for the ſame Year. The Fourth ſhews whether the *Declination* be *North* or *South*; N ſtands for *North*, S for *South.* The Fifth ſhews the Difference in Degrees and Minutes of *Right Aſcenſion* of the *Stars*, between the Years 1600. and 1670. The Sixth ſhews the Difference of *Declination*; and whether it be *North* or *South.* The Seventh ſhews the *Right Aſcention* in Degrees and Minutes for the Year 1670. The Eight ſhews the *Declination* in Degrees and Minutes for the ſame Year.

By this *Table* you may perceive the Fixed *Stars* increaſe in *Right Aſcenſion*, till they come to the *Vernal Colcur*; from whence the number of their *Right Aſcenſion* is reckoned: and by the Column of their Difference of *Right Aſcenſion*, you may ſee how much they increaſe in 70 Years. And if you would know how much they increaſe for any other number of Years, you muſt find what proportion they have to 70, and the ſame proportion the Difference of the *right Aſcenſion* of the *Stars* will have to the difference in the *Table*.

Example.

I would know the Difference of *Right Aſcenſion* the *Pole-Star* will have in 35 Years. I find in the fifth Column the Difference of *Right Aſcenſion* of the *Pole Star* to be 3 Degrees 59 Minutes; Therefore by the *Rule of Proportion*, I ſay, if 70 Years give 3 Degrees 59 Minutes, 35 Years ſhall give 1 Degree 59½ Minutes, and ſo proportionably for any other Number of Years.

Though this Rule ſerves for finding the Difference of *Right Aſcenſion* of any *Star*; yet it will not ſerve for finding the difference of any *Stars Declination*. For the *Stars* on the *North* ſide the *Equinoctial* between the *Hyemnal* and *Solſtitial Colures*, and on the *South* ſide the *Equinoctial* between the *Soliſtitial* and *Hyemnal Colures* increaſe in *Declination*. But the *Stars* on the *South* ſide the *Equinoctial* between the *Hyemnal* and *Solſtitial Colures*, and on the *North* ſide the *Equinoctial* between the *Solſtitial* and *Hyemnal Colures*, decreaſe in *Declination*, as you may yet more plainly ſee by the Globe if you bring 66½ Degrees of the *Meridian* to the *North* ſide of the *Horizon*, and ſcrew the *Quadrant of Altitude* to 66½ Degrees in the *Zenith*, and *Declination* of the *Pole* of the *Ecliptick*; and bring the *Hyemnal Colure* to the *Meridian*, for ſo ſhall the Pole of the *Eclipt*i*ck* be joined with the Center of the *Quadrant of Altitude*, and the *Eclipti*c*k* with the *Horizon*; and all the Circles that the ſeveral Degrees on the *Quadrant* make in a Revolution from *VVeſt* to *Eaſt* upon the *Poles* of the *Eclipti*c*k*, repreſent the great Revolution of every *Star* that each Degree on the *Quadrants* cuts. And thus demonſtratively will be repreſented the Progreſs of the Fixed *Stars* through every Degree of *Longitude*, and by conſequence the *Alteration* of their *right Aſcenſion* and *Declination*. For, imagining that Degree of the *Quadrant of Altitude* to be the *Star*, which juſt reaches the

Star; you may by turning aboute the *Quadrant*, ſee how Obliquely the *Star* (or the Degree repreſenting the *Star*) either Moves about, or cuts the *Equinoctial*, and all Circles *parallel* to the *Equinoctial*; and thereby Obſerve it ſome times to *Incline* in *Motion* to, and other times to Decline in Motion from the *Equinoctial*. But how long Time it will be ere the *Star* Inclines to, or Declines from the *Equinoctial*, you may know by finding the Diſtance of *Longitude* in Degrees it hath from either the *Solſtitial* or *Hyemnal Colure*; and with reſpecting the foregoing Rules in its Poſition, you may by the *Table* in Book 1. Chap. 3. Sect. 3. ſatisfie your ſelf.

Example.

The moſt *Northerly Star* in the *Girdle of Orion* doth yet Decreaſe in *Declination*.But I would know how long it ſhall Decreaſe; Therefore by the 32 Probleme, I find the *Longitude* of that *Star* to be for the Year 1670. 77 Degrees 51 Minutes, which Subducted out of 90 (the Diſtance of the *Solſtitial Colure* from the *Equinoctial*) leaves 12. 9 for the Diſtance of that *Star* from the *Solſtitial Colure*. Therefore by the *Table* aforeſaid, I find what number of Years anſwers to the motion of 12 Degrees 9 Minutes. And becauſe I cannot find exactly the ſame number of Degrees and Minutes in the *Table*, I take the number the neareſt to it, which is 14 Degrees 10 Min. and that is the Motion of the *Ecliptick* in 1000 Years. But becauſe this 14 Degrees 10 Minutes is 2 Degrees 1 Minute too much, I ſeek 2 Degrees 1 Minute in the *Table*,and the number of Years againſt it I would Subduct from the number of Years againſt 14 Degrees 10 Min. and the Remainder would be the number of Years required: But neither can I find 2 Degrees 1 Minute, therefore I muſt take the number of Degrees and Minutes neareſt to it, which is 2 Deg. 50 Min. and that yields 200 Years; which ſubducted out of 1000 leaves 800 Years. But becauſe this is alſo too much by the Motion of 49 Minutes, Therefore I ſeek for 49 Minutes in the Table, and Subduct the number of Years againſt it from 800, and the Remainder would be the number of years required. But neither is 49 Min. in the Table, Therefore I take the neareſt to it,which is 51 Min. and that yields 60 Years; which Subducted out of 800, leaves 740.But this is likewiſe too much by the Motion of two Minutes. Therefore I ſeek 2 Min. in the *Table*, but cannot find it nearer than 2½, and againſt it I find 3 Years, which 3 Years I Subduct out of 740, and the Remainder is 737 the number of Years required. You may if you pleaſe for exactneſs, Subduct for the ½ Minutes 8 Months; ſo have you 736 Years 4 Months, for the Time that the moſt *Northerly Star* in the *Girdle of Orion* will Decreaſe in *Declination*, after the Year 1670, which will be till *Ann. Dom.* 2406. after which time it will increaſe in *Declination* for 12706 Years together, till it come to have 47 Degrees 8 Minutes of Declination: At which time it will be in or very near the place of the moſt *Southerly Star* of the *Southern Crown*, and that *Star* in its place.

And thus the *Pole Star* is now found to Increaſe in *Declination*, and will yet this 421 Years: After which time it will Decreaſe in *Declination* for 12706 Years together, till it come to be within 42 Degrees 42 Minutes of the *Equinoctial*, in the void ſpace now between *Draco* and *Lyra*; at which time *Lyra* will be almoſt as near the *Pole*, as the *Pole Star* now is; and then the moſt proper to be the *Northern Pole Star*: And the laſt *Star* in the *Stalk of the Dove's Mouth* will be then very near the *Southern Pole*, and therefore moſt fit to be the *Southern Pole Star*.

PROB. XXVIII.

The place of the Sun *or any* Star *given, to find the* Oblique Aſcenſion, *and the* Oblique Deſcenſion, *in any given* Latitude.

THE *Globe* Rectified, Bring the place of the *Sun* or *Star* to the *Meridian* under the *Horizon*, and the Degree of the *Equinoctial* that comes to the *Meridian* with it under the *Horizon* is the Degree of *Right Deſcenſion*. If the *Sun* or *Star* will reach no part of the *Horizon* under the *Horizon*, they have no *Right Deſcenſion*.

For the Oblique Aſcenſion.

Bring the place of the *Sun* or the *Star* to the *Eaſt* ſide the *Horizon*, and the Degree of the *Equator* cut by the *Horizon*, is the Degree of *Oblique Aſcenſion* of the *Sun* or *Star*.

For

For the Oblique Deſcenſion.

Bring the place of the *Sun* or *Star* to the *Weſt* ſide the *Horizon*, and the Degree of the *Equinoctial* cut by the *Horizon* is the Degree of *Oblique Deſcenſion*. They need no *Example*.

PROB. XXIX.

Any Place on the Terreſtrial Globe *being given, to find its* Antipodes.

BRing the given Place to the *Meridian*, ſo may you (as by the firſt Probleme) ſee its *Longitude* and *Latitude*; then turn about the G*lobe* till 180 Degrees of the *Equator* paſs through the *Meridian*; and keeping the *Globe* to this *Poſition*, number on the *Meridian* 180 Degrees from the *Latitude* of the given Place; and the point juſt under that Degree is the *Antipodes*.

Example.

I would find the *Antipodes* of *Cuida Real*, an Inland Town of the *VVeſt-Indies*, which lies upon the River *Parana*, an Arm of *Rio de la Plata*: Therefore I bring *Cuida Real* to the *Meridian*, and find (as by the firſt Problem) its *Latiude* 23. 50. *South*; and its *Longitude* 333 Degrees: Then I turn about the *Globe* till 180 Degrees of the *Equatcr* paſs through the *Meridian*; and keeping the *Globe* to that poſition, I number ſo many Degrees *North Latitude* as *Parana* hath *South*, viz. 23. 50. and juſt under that Degree, I find *Lamoo*, a Town lying upon the Coaſt of *China*, in the Province of *Quincii*: Therefore I ſay *Lamoo* is juſt the Antipodes of *Cuida Real*.

Another way.

Bring the given Place to the *North* or *South* point of the *Horizon*, and the point of the *Globe* denoted by the oppoſite point of the *Horizon* is the *Antipodes* of the given *Place*.

PROB. XXX.

To find the Perecii *of any given Place, by the* Terreſtrial Globe.

BRing your given Place to that ſide the *Meridian* which is in the *South* Notch of the *Horizon*, and follow the *Parallel* of that Place on the *Globe*, till you come to that ſide the *Meridian*, which is in the *Northern* Notch of the *Horizon*, and that in the *Perecii* of your Place.

PROB. XXXI.

To find the Antecii *of any given Place, upon the* Terreſtrial Globe.

BRing your given Place to the *Meridian*, and find its *Latitude* by the firſt Probleme; If it have *North Latitude*, count the ſame number of Degrees on the *Meridian* from the *Equator Southwards*; but if it have *South Latitude*, count the ſame number of Degrees from the *Equator Northwards*, and the Point of the *Globe* directly under that number of Degrees, is the *Antecii* of your Place.

PROB. XXXII.

To find the Longitude *and* Latitude *of the* Stars *by the* Celeſtial Globe.

THE *Quadrant of Altitude* will reach but 90 Degrees, as was ſaid Prob. 9. Therefore if the *Star* you enquire after be on the *North* ſide the *Ecliptick*; Elevate the *North Pole* $66\frac{1}{2}$ Degrees above the *North* ſide the *Horizon*: If on the *South* ſide the *Ecliptick*, you muſt Elevate the *South Pole* $66\frac{1}{2}$ Degrees above the *South* ſide the *Horizon*: Then bring the *Solſtitial Colure* to the *Meridian* on the *North* ſide the *Horizon*, and ſcrew the *Quadrant of Altitude* to the *Zenith*, which will be in 23 Degrees 30 Minutes from the *Pole* of the *World*: So ſhall the *Ecliptick* lye in the *Horizon*, and the *Pole* of the *Ecliptick* alſo lye under the Center of the *Quadrant of Altitude* (as was ſhewed Prob. 27.) Now to find the *Longitude* of any *Star*, do thus, Turn the *Quadrant of Altitude* about, till the Graduated Edge of it lie on the *Star*; and the Degree in the *Ecliptick* that the *Quadrant* touches, is the *Longitude* of that *Star*.

Example, For a Star *on the* North *ſide the* Ecliptick.

I would know the *Longitude* of *Marchab*, a Bright *Star* in the Wing of *Pegaſus*: I find it on the *North* ſide the *Ecliptick*; Therefore I Elevate the *North Pole*, and placing ♋ on the *North* ſide the *Meridian*, I ſcrew the *Quadrant of Altitude* to the *Zenith*, as aforeſaid; then laying the Edge of the *Quadrant of Altitude* upon that *Star*, I find that the end of it reaches in the *Ecliptick* to ♓ 18.56. Therefore I ſay, the *Longitude* of *Marchab* is ♓ 18.56.

For the Latitude *of a* Star.

The Degree of the *Quadrant of Altitude* that touches the *Star*, is the *Latitude* of the *Star*.

Example.

The *Globe* and *Quadrant* poſited as before, I find 19 Degr. 26 Min. (accounted upwards on the *Quadrant*) to touch *Marchab* aforeſaid: Therefore I ſay, the *Latitude* of *Marchab* is 19 Degrees 26 Minutes.

And thus by Elevating the *South Pole*, and placing the *Globe* and *Quadrant of Altitude* as aforeſaid, I ſhall find *Canicula* have 15 Degrees 57 Minutes *South Latitude*, and 21 Degrees 18 Minutes in ♋ *Longitude*.

PROB. XXXIII.

To find the Diſtance *between any two* Places, *on the* Terreſtrial Globe.

THis may be performed either with the *Quadrant of Altitude*, or with a pair of *Compaſſes*; with the *Quadrant of Altitude*, thus: Lay the lower end thereof to one Place, and ſee what Degree reaches the other Place, for that is the number of Degrees between the two Places. If you Multiply that number of Degrees by 60, the Product ſhall be the number of *Engliſh Miles* between the two Places.

Example.

I would know the *Diſtance* between *London* and the moſt *Eaſterly* Point of *Jamaica*; I lay the lower end of the *Quadrant of Altitude* to *Jamaica*, and extending the other end towards *London*, I find $68\frac{1}{2}$ Degrees comprehended between them; Therefore I ſay $68\frac{1}{2}$ is the number of Degrees comprehended between *London* and *Jamaica.*

If you would find the Diſtance between them with your *Compaſſes*, you muſt pitch one Foot of your *Compaſſes* in the *Eaſt* Point of *Jamaica*, and Open your *Compaſſes*, till the other Foot reach *London*; and keeping your *Compaſſes* at that diſtance, apply the Feet to the *Equinoctial Line*, and you will find $68\frac{1}{2}$ Degrees comprehended between them, as before.

If you Multiply $68\frac{1}{2}$ by 60, it gives 4114 *Engliſh Miles.*
If you Multiply it by 20, it gives 1370 *Engliſh Leagues.*
If you Multiply it by $17\frac{1}{2}$, it gives 1199 *Spaniſh Leagues.*
If you Multiply it by 15, it gives 1054 *Dutch Leagues.*

PROB. XXXIV.

To find by the Terreſtrial Globe, *upon what* Point of the Compaſs *any two* Places *are Situate one from another.*

Find the two Places on the *Terreſtrial Globe*, and ſee what *Rhumb* paſſes through them; for that is the Point of the *Compaſs* they bear upon.

Example.

Briſtol and *Bermudas* are the Places. I examine what *Rhumb* paſſes through them both; and becauſe I find no *Rhumb* to paſs immediately through them both, therefore I take that *Rhumb* which runs moſt Parallel to both the Places; which in this *Example* is the Tenth *Rhumb*, counted from the *North* towards the left Hand; and is called, as you may ſee by this following

Figure *Weſt South Weſt*; Therefore I ſay, *Bermudos* lies Situate from *Briſtol Weſt South Weſt*; and by contraries, *Briſtol* lies Situate from *Bermudos Eaſt North Weſt*.

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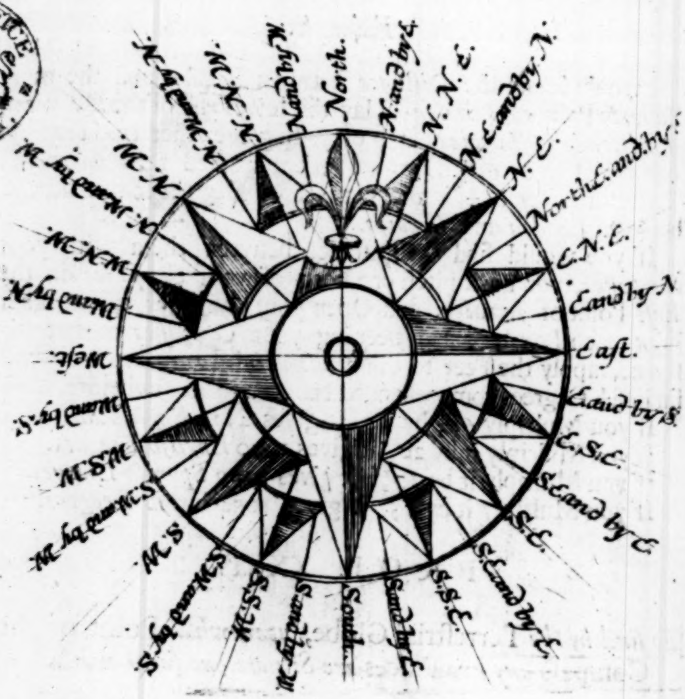

North.
N and by E.
N.N.E.
N.E. and by N.
N.E.
North E. and by E.
E.N.E.
E and by N
East.
E and by S.
E.S.E.
S.E. and by E.
S.E.
S.E. and by S.
S.S.E.
S and by E.
South.
S and by W.
S.S.W.
S.W. and by S.
S.W.
S.W. and by W.
W.S.W.
W and by S.
West.
W and by N.
W.N.W.
N.W. and by W.
N.W.
N.W. and by N.
N.N.W.
N and by W.

PROB. XXXV.

To find by the Celeſtial Globe, *the* Coſmical Riſing *and* Setting *of the* Stars.

WHEN any *Star* Riſes with the *Sun*, it is ſaid to Riſe *Coſmically*.

And when any *Star* Sets when the *Sun* Riſes, it is ſaid to Set *Coſmically*.

To find theſe, Rectifie the *Globe* to the *Latitude* of your

Place, and bring the place of the *Sun* to the Eaſt ſide the *Horizon*; and the *Stars* then cut by the Eaſtern Semi-circle of the *Horizon*, Riſe *Coſmically*; and thoſe *Stars* cut by the Weſtern Semi-circle of the *Horizon*, Set *Coſmically*.

Example.

November 9. I would know what *Stars* Riſe and Set *Coſmically*, here at *London*. The *Suns* place found, as by the Third Probleme, is ♏ 27. Therefore I bring ♏ 27 to the Eaſt ſide the *Horizon*, and in the Eaſtern Semi-circle, I find Riſing with the *Sun* the Right Wing of *Cygnus*, the *Star* in the end of *Aquila*'s Tail, *Serpentarius* and *Centaurus*. Therefore theſe *Conſtellations* are ſaid to Riſe *Coſmically*. In the Weſtern Semi-circle of the *Horizon* I find Setting *Andromeda*, the Triangle, *Taurus*, *Orion*, *Canis major*, and *Argo Navis*; Therefore I ſay, theſe *Conſtellations* Set *Coſmically*.

PROB. XXXVI.

To find by the Celeſtial Globe, *the* Acronical Riſing *and* Setting *of the* Stars.

THE *Stars* that Riſe when the *Sun* Sets, are ſaid to Riſe *Acronically*. And,

The *Stars* that Set with the *Sun*, are ſaid to Set *Acronically*.

To find theſe, Rectifie the *Globe* to the *Latitude* of your Place, and bring the place of the *Sun* to the *Weſt* ſide the *Horizon*; and the *Stars* that cut by the *Eaſtern* Semi-circle of the *Horizon*, Riſe *Acronically*: And thoſe *Stars* cut by the *Weſtern* Semi-circle of the *Horizon*, Set *Acronically*.

Example.

November 9. I would know what *Stars* Riſe and Set *Acronically* here at *London*. The *Suns* place, as before, is ♏ 27. Therefore I bring *Scorpio* 27 to the Weſt ſide the *Horizon*; and in the Eaſtern Semi-circle I find Riſing the *Southern Fiſh*, *Fomahant*, *Cetus*, *Taurus*, *Auriga*, and the *Feather in Caſtor*'s *Cap*. Therefore theſe *Conſtellations* are ſaid to Riſe *Acronically*. In the *Weſtern* Semi-circle of the *Horizon* I find Setting the *Lyons Tail*, *Virgo*, *Scorpio*, and *Sagittarius*; therefore I ſay theſe *Conſtellations Set Acronically*.

PROB. XXXVII.

To find by the Celeſtial Globe, *the* Heliacal Riſing *and* Setting *of the* Stars.

WHen a *Star*, formerly in the *Suns* Beams, gets out of the *Suns* Beams, it is ſaid to *Riſe Heliacally*. And,

When a *Star*, formerly out of the *Suns* Beams, gets into the *Suns* Beams, it is ſaid to *Set Heliacally*.

A *Star* is ſaid to be in the *Sun* Beams, when it is made inconſpicuous, by reaſon of its nearneſs to the *Suns* Light. The bigger *Stars* are diſcernable more near the *Suns* Light, than the leſſer are; for, *Stars* of the Firſt *Magnitude* may (according to the received Rules of Ancient Authors) be ſeen when the *Sun* is but 12 Degrees below the *Horizon*; but *Stars* of the Second *Magnitude* cannot be ſeen, unleſs the *Sun* be 13 Degrees below the *Horizon*: *Stars* of the Third *Magnitude* require the *Sun* to be 14 Degrees below the *Horizon* e're they can be ſeen; of the Fourth *Magnitude* 15 Degrees, of the Fifth *Magnitude* 16 Degrees, of the Sixth *Magnitude* 17 Degrees; the *Nebulous* ones 18 Degrees. Yet this Rule is not ſo certain, but that either Clear or Cloudy Weather may alter it. Read more of this Subject in Mr. *Palmer* on the *Planiſphere*, Book 4. Chap. 20.

Now to find the Time that any *Star* ſhall *Riſe Heliacally*, do thus; Rectifie the *Globe* and *Quadrant of the Altitude* to your *Latitude*, then bring the given *Star* to the *Eaſt* ſide the *Horizon*, and turn the *Quadrant of Altitude* into the *Weſt* ſide, and ſee what Degree of the *Ecliptick* is elevated ſo many Degrees above the *Horizon* as the *Magnitude* of the *Star* you enquire after requires, according to the foregoing Rules; for the oppoſite Degree of the *Ecliptick*, is the Degree the *Sun* ſhall be in when the *Star Riſes Heliacally*. Having the Degree of the *Ecliptick* the *Sun* is in, you may find the Day of the Month by the Fourth Probleme.

Example.

I would know when *Cor Leonis* ſhall *Riſe Heliacally* here at *London*; Therefore I Rectifie the *Globe* and *Quadrant of Altitude* for *London*, and bring *Cor Leonis* to the *Eaſt* ſide the *Horizon*, and turn the *Quadrant of Altitude* into the *Weſt*; and becauſe *Cor Leonis* is a *Star* of the Firſt *Magnitude*, therefore I ſee what Degree of the *Ecliptick* is Elevated in the *Weſt* ſide the *Horizon* 12 Degrees on the *Quadrant of Altitude*, and find *Piſces* 9 Degrees. Now the Degree of the *Ecliptick* oppoſite to ♓ *9.* is ♍ *9.* Therefore I ſay, when the *Sun* comes to ♍ *9* Degrees (which by the Fourth Probleme I find is *Auguſt* 23.) *Cor Leonis* ſhall *Set Heliacally.*

For the Heliacal Setting.

The *Globe*, &c. Rectified, as before: Bring the *Star* to the *Weſt* ſide the *Horizon*, then ſee what Degree of the *Ecliptick* is Elevated on the *Quadrant of Altitude*, on the Eaſtern ſide the *Horizon*, ſo many Degrees as the *Stars Magnitude* requires; for when the *Sun* comes to the oppoſite Degree of the *Ecliptick*, that *Star* ſhall *Set Heliacally.*

Example.

I would know when *Bilanx*, a *Star* in the Beam of the Scales, will *Set Heliacally* here at *London*. The *Globe* and *Quadrant* rectified, I bring *Bilanx* to the *Weſt* ſide the *Horizon*, and turn the *Quadrant of Altitude* into the *Eaſt*; Then I examine what Degree of the *Ecliptick* is elevated 13 Degrees of the *Quadrant of Altitude*, (becauſe *Bilanx* is a *Star* of the Second *Magnitude*) and find ♉ 4½ oppoſite to ♉ 4½ is *Scorpio* 4½; Therefore I ſay, when the Sun comes to *Scorpio* 4½, (which by Prob. 4. will be *October* 18.) *Bilanx* ſhall *ſet Heliacally.*

PROB. XXXVIII.

To find the Diurnal *and* Nocturnal *Arch of the* Sun *or* Stars, *in any given* Latitude.

THE *Semi-Diurnal Arch*, is the number of Degrees of the *Equinoctial* that paſſes thro' the *Meridian*, whiles the *Sun*, or any *Star* is aſcending above the Eaſt ſide the *Horizon* to the *Meridian*.

To know the number of Degrees it contains, Rectifie the *Globe* to the given *Latitude*, and bring the Place of the *Sun* or *Star* to the Eaſt ſide the *Horizon*, and note what number of Degrees of the *Equinoctial* is then cut by the *Meridian :* Then remove the Place of the *Sun* or *Star* to the *Meridian*, and ſee again what number of Degrees of the *Equinoctial* is then cut by the *Meridian*, and ſubtract the former from the latter, and the Remainder ſhall be the number of Degrees of the *Sun* or *Stars Semi-Diurnal Arch*. But note, if the *Equinoctial* Point ♈ paſs through the *Meridian*, while the *Sun* or *Star* is turned from the Eaſt ſide the *Horizon* to the *Meridian*, then you muſt ſubtract the number of Degrees of the *Equinoctial* cut by the *Meridian*, when the *Sun* or *Star* is at the Eaſt ſide the *Horizon* from 360 Deg. and to the Remainder add the number of Degrees of the *Equinoctial* that comes to the *Meridian*, with the place of the *Sun* or *Star*, and the Sum of them both, is the number of Degrees of the *Sun* or *Stars Semi-diurnal Arch*; which being doubled, is the number of Degrees of the whole *Diurnal Arch*; and which being ſubtracted from 360, gives the *Nocturnal Arch*.

Example of the Sun.

Having rectified the *Globe*, I would, *May* 10. know the *Diurnal Arch* of the *Sun :* His place, found by Prob. 3. is ♉ 29. Therefore I bring ♉ 29 to the *Eaſt* ſide the *Horizon*, and find then at the *Meridian* 299 Deg. 30 Min. of the *Equinoctial*; then I turn the place of the *Sun* to the *Meridian*, and find 56 Degr. 30 Min. of the *Equinoctial* come to the *Meridian* with it. Here the *Equinoctial* Point ♈ paſſes through the *Meridian*, while the *Sun* moves between the *Horizon* and the *Meridian*; Therefore, as aforeſaid, I ſubtract the Firſt number of Degrees and Minutes, *viz.* 299 Degr. 30 Min. from 360 Degr. and there remains 60 Degr. 30 Min. for the number of Degr. and Min. contained between the Degree of the *Equinoctial* at the *Meridian*, and the *Equinoctial* Point *Aries*; and to this 60 Deg. 30 Min. I add the Second number of Degr. and Min. *viz.* 56 Degr. 30 Min. the number of Degr. and Min. between the Point *Aries*, and the Deg. of the *Equinoctial* at the *Meridian*, and they make together 117 Degr. for the *Suns Semi-diurnal*

Arch: By doubling of which, you have 234 Degrees for the *Suns Diurnal Arch*; and by Subtracting 234 (the *Diurnal Arch*,) from 360, you have 126 Degrees, for the *Suns Nocturnal Arch*.

Example, for a Star.

I take *Sirius*, a Bright *Star* in the *Great Dogs Mouth*. The *Globe* Rectified, as before, I bring *Sirius* to the *Eaſt*-ſide the *Horizon*, and find then 29 Degrees 30 Min. of the *Equinoctial* at the *Meridian*, then I turn *Sirius* to the *Meridian*, and find 97 Degrees 38 Minutes of the *Equinoctial* come to the *Meridian* with it. Therefore I ſubtract the firſt Number, *viz.* 29 Deg. 30 Minutes, from the Second, 97. 38. and the Remains is 68 Degrees 8 Minutes, for the *Semi-Diurnal Arch* of *Sirius*.

His *Nocturnal Arch* you may find as before.

PROB. XXXIX.

To find the Azimuth *and* Almicantar *of any* Star.

THis Probleme is like the 22 and 23 Problemes, which ſhew the finding the *Azimuth* and *Almicantar* of the *Sun*; only whereas there you were directed to bring the Degree of the *Sun* to the *Quadrant of Altitude*, you muſt now bring the *Star* propoſed to the *Quadrant of Altitude*; and by the Directions in thoſe Problemes, the Reſolution will be found.

PROB. XL.

To find the Hour *of the* Night, *by Obſerving two known* Stars *in one* Azimuth *or* Almicantar.

REctifie the *Globe*, *Quadrant*, and *Hour-Index*. Then find the two known *Stars* on the *Globe*; and if the two *Stars* be in one *Azimuth*, turn about the *Globe* and *Quadrant* of *Altitude*, till you can fit the two *Stars*, to lye under the Graduated Edge of the *Quadrant of Altitude*; ſo ſhall the *Index* of the *Hour-Circle* Point at the Hour of the Night. If the two *Stars* be in one *Almicantur*, Turn the *Globe* forward or backward, till the two *Stars* come to ſuch a Poſition, that by moving the *Quadrant of Altitude*, the ſame Degree on it will lye on both the *Stars*; ſo ſhall the *Index* of the *Hour-Circle* point at the Hour of the Night.

PROB. XLI.

The Hour *given that any* Star *in* Heaven *comes to the* Meridian, *to know thereby the Place of the* Sun, *and by conſequence the* Day *of the* Month, *though it were loſt.*

BRing the *Star* propoſed to the *Meridian*, and turn the *Index* of the *Hour-Circle* to the Hour given; then turn about the *Globe* till the *Index* point at the Hour of 12 for Noon; and the place of the *Sun* in the *Ecliptick* ſhall be cut by the *Meridian*.

Example.

March 7. at 11 a Clock at Night the *Pointers* come to the *Meridian* of *London*. Therefore I place the *Pointers* (on the *Celeſtial Globe*) under the *Meridian*, above the *Horizon*, and turn the *Index* of the *Hour-Circle* to 11 paſt Noon; Afterwards I turn back the *Globe* till the *Index* point to 13 at Noon; Then looking in the *Ecliptick*, I find the *Meridian* cut in *Piſces* 26 Degrees 45 Minutes; Therefore I ſay, when the *Pointers* come to the *Meridian* at 11 a Clock at Night, the place of the *Sun* is *Piſces* 26. 45. Having thus the place of the *Sun*, I may find the *Day* of the *Month* by the Fourth Probleme; and ſo either know the Day that the *Pointers* come to the *Meridian* at 11 Clock at Night, or any other Hour given.

The Day of the Month might alſo be found by the *Declination*, and the Quarter of the *Ecliptick* the *Sun* is in, given: For the *Meridian* will cut the Degree of the *Suns* place in the *Ecliptick* in the *Parallel* of *Declination*: So that having reſpect to the Quarter of the *Ecliptick*, you'll find the *Suns* place; and having the *Suns* place, you may (as aforeſaid) find the Day of the Month.

PROB.

PROB. XLII.

The Day *of the* Month *given to find in the* Circle *of* Letters *on the Plain of the* Horizon, *the* Day *of the* Week.

THE ſeven Days of the Week, were by the Idolatry of the Ancient *Roman* Heatheniſh Times, dedicated to the Honour of ſeven of their Gods, which we call *Planets*. The firſt is the moſt eminent, and therefore doubtleſs by them ſet in the firſt place, called *Dies Solis*, or the *Suns* Day: The ſecond *Dies Lunæ*, the *Moons* Day: The third *Dies Martis*, the Day of *Mars*, by us called *Tueſday*: The fourth *Dies Mercurii*, *Mercuries* Day, by us called *Wedneſday*, from *Woden*, an Idol the *Saxons* worſhip'd, to whoſe Honour they dedicated that Day, and is by all thoſe *Germain* Nations ſtill called *Wodenſdagh*: The fifth *Dies Jovis*, *Jupiter* or *Joves* Day; which doubtleſs the *Saxons* (from whom probably we receive it) call'd *Donderdagh*, becauſe *Jupiter* is the God of Thunder; and we either by Corruption, or for ſhortneſs, or both, call'd it *Thurſday*: The ſixth *Dies Veneris*, the Day of *Venus*: But the *Saxons* transferring her Honour to another of their Goddeſſes, named *Fria*, call'd it *Fridagh*; and we from them call it *Friday*: The ſeventh is *Dies Saturni*, *Saturns* Day.

The ſame Day of the Month in other Years happens not on the ſame Day of the Week, therefore the *Dominical Letter* for one Year is not the ſame, it is the next: Now becauſe you cannot come to the knowledge of the Day of the Week, unleſs you firſt know the *Sundays Letter*, therefore have I in Prob. 53. inſerted a Table of Mr *Palmer*'s, by which you may find the *Dominical* or *Sundays Letter* for ever; and having the *Dominical Letter*, you may in the Circle of Letters on the *Horizon* find it near the Day of that Month, and count that for *Sunday*, the next under it for *Monday*, the next under that for *Tueſday*, and ſo in order, till you come to the Day of the Month.

Example.

I would know what Day of the Week, *June* 1. *Anno* 1658. *Old Stile*, falls on; I find by the *Table* aforeſaid, the *Dominical*

Letter is C, then I look in the *Calender* of *Old Stile* for *June* 1. and againſt it I find Letter E, which becauſe it is the ſecond Letter in order from C, therefore it is the ſecond Day in order from *Sunday*, which is *Tueſday*.

PROB. XLIII.

The Azimuth *of any* Star *given, to find its* Hour *in any given* Latitude.

THe *Hour of a Star*, is the number of Hours that a *Star* is diſtant from the *Meridian*. To find which, Rectifie the *Globe* and *Quadrant of Altitude*, and bring the *Star* propoſed to the Meridian, and the *Index* of the *Hour-Circle* to 12. Then place the lower end of the *Quadrant of Altitude*, to the given *Azimuth* in the *Horizon*, and turn the *Globe* till the *Star* come to the Graduated Edge of the *Quadrant of Altitude*; ſo ſhall the *Index* of the *Hour-Circle* point at the *Hour of the Star*. Only this caution you muſt take; if the *Star* were turned from the *Meridian* towards the *Eaſtern*-ſide of the *Horizon*, you muſt Subtract the number of Hours the *Index* points at from 12, and the Remainder ſhall be the *Hour of the Star*. But if the *Star* were turned from the *Meridian* towards the *Weſt*-ſide of the *Horizon*, the *Hour-Index* points at, is (without more ado) the *Hour of the Star*.

PROB. XLIV.

How you may learn to know all the Stars *in* Heaven, *by the* Celeſtial Globe.

REctifie the *Globe*, *Quadrant*, *Hour-Index*, and *Horizon*, as by Prob. 2. then turn about the *Globe*, till the *Index* of the *Hour-Circle* point at the Hour of the Night on the *Hour-Circle*. Then if every *Star* on the *Globe* had a Hole in the midſt, and your Eye were placed in the Centre of the *Globe*, you might by keeping your Eye in the Centre, and looking through the Hole of any *Star* on the *Globe*, ſee its *Match* in *Heaven*; that is, the ſame *Star* in *Heaven*, which that *Star* on the *Globe* repreſents: For from the Centre of the Globe, there proceeds a ſtraight

Line through the *Star* on the *Globe*, even to the ſame *Star* in *Heaven*. Therefore, thoſe *Stars* that are in the *Zenith* in *Heaven*, will then be on the *Zenith* on the *Globe*; thoſe that are in the *Eaſt* in *Heaven*, will be in the *Eaſt* on the *Globe*; thoſe in the *Weſt* in *Heaven*, in the *Weſt* on the *Globe*; and thoſe *Stars* that are in any *Altitude* in *Heaven*, will at the ſame time have the ſame *Altitude* on the *Globe*; ſo that if you ſee any *Star* in *Heaven* whoſe Name you deſire to know, you need but obſerve its *Azimuth* and *Altitude*; and in the ſame *Azimuth* and *Altitude* on the *Globe*, you may find the ſame *Star*; and if it be an Eminent *Star*, you will find its Name adjoined to it.

Example.

December 10. at half an Hour paſt *9* a Clock at Night here at *London*, I ſee two Bright *Stars* at a pretty Diſtance one from another in the *South*; I deſire to know the Names of them: Therefore having the *Globe* Rectified to the *Latitude* of *London*, and the *Quadrant of Altitude* ſcrewed to the *Zenith*, the *Hour-Index* alſo Rectified, and the *Horizon* poſited *Horizontally*, as by Prob. 2. I obſerve the *Altitude* of thoſe *Stars* in *Heaven* (either with a *Quadrant*, *Aſtrolabe*, *Croſs-ſtaff*, or the *Globe* it ſelf, as hath been ſhewed, Prob. *13*. *16*.) to be, the one 78 Degrees, the other 42 Degrees above the *Horizon*. Therefore, having their *Altitudes*, I count the ſame Number of Degrees as for the Firſt 78 upon the *Quadrant of Altitude* upwards, and turn it into the *South*, under the *Meridian*, and ſee what *Star* is under 78 Degrees; for that is the ſame *Star* on the *Globe* which I ſaw in *Heaven*. Now at the firſt Examination of the *Globe*, you may ſee that that *Star* is placed in the Eye of that *Aſteriſme*, which is called *Caput Meduſæ*, and indeed, that being the only *Star* of Note in that *Conſtellation*, bears the Name of the whole *Conſtellation*. The other *Stars* about it, you may eaſily know by their Situation: As ſeeing two little *Stars* to the *Weſtward* of that *Star* in *Heaven*, you may ſee on the *Globe*, that the hithermoſt is in the other Eye of *Caput Meduſæ*, and the furthermoſt in the *Hair* of *Snakes* of the ſame *Aſteriſme*. Looking a little to the *Southwards* of thoſe *Stars* in *Heaven*, you may ſee two other ſmall *Stars*, a little below thoſe in the *Eyes*: Therefore, to know thoſe alſo, you may look on the *Globe*, and ſee, that there is one on the

Noſe, and another *Star* in the Cheek of *Caput Meduſæ*.

In like manner for the Second *Star* in the *Meridian*, which is 42 degrees above the *Horizon:* If you move the *Quadrant of Altitude* (as before) to the *South* or *Meridian*, and count 42 degrees upon the *Quadrant of Altitude*, you will find a *Star* of the Second Magnitude in the Mouth of the *Whale:* Therefore you may ſay, that *Star* in *Heaven* is in the Mouth of the *Whale*; and becauſe cloſe to it on the *Globe* is written *Menkar*; Therefore you may know the Name of that *Star* in *Heaven* is *Menkar.*

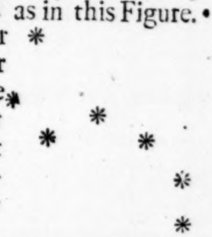
In the *South Eaſt and by South*, 56 degrees above the *Horizon*, I ſee a very Bright *Star* in *Heaven*; therefore I bring the *Quadrant of Altitude* to the *South Eaſt and by South* Point in the *Horizon*, and find under 56 degrees of the *Quadrant of Altitude* a Great *Star*, to which is ſet the Name *Oculus Tauri*; therefore I ſay, the Name of that Bright *Star* in *Heaven* is *Oculus Tauri.*

In the *South Eaſt* in *Heaven* you may ſee three Bright *Stars* lye directly in a ſtraight Line from one another, the middlemoſt whereof is 25 degrees, or thereabouts, above the *Horizon*, therefore bring the *Quadrant of Altitude* to the *South Eaſt* Point of the *Horizon*, and about 25 degrees above the *Horizon* you will ſee the ſame Great *Stars* on the *Globe*, in the *Girdle of Orion*; therefore thoſe *Stars* are called *Orion*'s *Girdle.*

At the ſame Time, *South Eaſt and by Eaſt*, you have about 10 degrees above the *Horizon*, the Brighteſt *Star* in *Heaven*, called *Sirius*, in the Mouth of the *Great Dog*; *Canicula*, a Bright *Star* in the *Little Dog*, Eaſt and by South, about 25 degrees above the *Horizon:* *Cor Leonis* juſt Riſing Eaſt North Eaſt; you have alſo at the ſame Time on the Eaſt ſide the *Horizon*, the Twins, *Auriga*, the *Great Bear*; and divers other *Stars*, eminent both for their Splendor and Magnitude.

In the *Weſt* ſide the *Horizon* you have *South Weſt and by Weſt*, about 4 degrees above the *Horizon*, a bright *Star* in the Right Leg of *Aquarius:* And all along to the *Southwards* in *Cetus* the Whale, you have other Eminent Bright *Stars:* More upwards towards the *Zenith*, you have a Bright *Star* in the Line of the two *Fiſhes:* Higher yet, you have the Firſt *Star* in ♈, an Eminent *Star*, becauſe the firſt in all *Catalogues* that we have cognizance of; and therefore probably in the *Equinoctial Colure*, when the *Stars* were firſt reduced into *Conſtellations*; yet more near the *Zenith*, you have a Bright *Star* in the *Left Leg of Andromeda:* From thence towards the *North*, you find other very Eminent Bright Stars in *Caſſiopea*, *Cepheus*, *Urſa minor*, in the *Tail* whereof is the *Pole Star*; and *Draco*, *Hercules*, where you turn back to *Lyra*, *Cygnus*, *Pegaſus*, the *Dolphin*, &c. all which, or any other, you may eaſily know by their *Altitude* above the *Horizon*, and the Point of the Compaſs they bear upon.

Thus knowing ſome of the moſt Eminent Fixed *Stars*, you may by the Figure of the Reſt come to the Knowledge of them alſo. For *Example*, Looking towards the *North North Eaſt* in *Heaven*, you may ſee Seven Bright *Stars*, conſtituted as in this Figure. Therefore looking towards the ſame Quarter on the *Globe*, you may (without taking their *Altitude*) ſee the ſame *Stars* lying in the ſame Figure in the Hinder Parts of the *Great Bear*; from whence you may conclude, that thoſe *Stars* in *Heaven* are ſituate in the Hinder Parts of the *Great Bear*. Theſe 7 *Stars* are by us called *Charles his Wain*.



Yet neverthelеſs you may ſee ſome *Stars* of Note in *Heaven*, which you ſhall not find on the *Globe*, and thoſe in or near about the *Ecliptick:* They are called *Planets*, and cannot be placed on the *Globe*, unleſs it be for a particular Time, with Black Lead, or ſome ſuch thing that may be rubb'd out again: Becauſe they having a continual Motion, always alter their Places. Of thoſe there are five in number, beſides the *Sun* and *Moon*, which are alſo *Planets*, though they ſhew not like Stars. Theſe five are called *Saturn*, *Jupiter*, *Mars*, *Venus*, *Mercury*; yet *Mercury* is very rarely ſeen, becauſe he never Riſing above an Hour before the *Sun*, or Setting above an Hour after, for the moſt part hath his Light ſo over-ſpread with the dazelling Beams of the Glittering *Sun*, that ſometimes when he is ſeen, he ſeems rather to be a Mote in the *Suns* Beams, than a Body endowed with ſo much Brightneſs as *Stars* and *Planets* ſeem to be.

Now there are divers Ways (by ſome of which) you may at all Times know thoſe *Planets* from the Fixed *Stars:* As firſt, their not Twinkling, for therein they differ from Fixed *Stars*; becauſe they moſt commonly do Twinkle, but *Planets* never; unleſs it be *Mars*; and yet he Twinkles but very ſeldom neither.

Secondly, They appear of a conſiderable *Magnitude*, as ♃

ſometimes appears Greater by far than a *Star* of the Firſt *Magnitude*, and ♀ many times Bigger than He. They are both Gliſtering *Stars* of a bright *Silver* Colour, but ♀ moſt Radiant, eſpecially when ſhe is in Her *Perigeon.* ♂ appears like a *Star* of the Second *Magnitude*, and is of a *Copperiſh* Colour. ♄ ſhews like a *Star* of the Third *Magnitude*, and is of a *Leaden* Colour; and he (of all others,) is moſt difficult to be known from a Fixed *Star*, partly becauſe of his Minority, and partly becauſe of the ſlowneſs of his Motion. ☿ is very ſeldom ſeen (as aforeſaid,) unleſs it be in a Morning, when he Riſes before the *Sun*, or in an Evening when he Sets after the *Sun:* He is of a pale whitiſh Colour, like *Quickſilver*, and appears like a *Star* of the Third *Magnitude:* He may be known by the Company he keeps; for he is never above 29 Degrees diſtant from the *Sun.*

Thirdly, The *Planets* may be known from the Fixed *Stars*, by their *Azimuths* and *Altitudes* obſerved, (as hath been taught before;) for if when you have taken the *Azimuth* and *Altitude* of the *Star* in *Heaven* you doubt to be a *Planet*, and you find not on the *Globe*, in the ſame *Azimuth* and *Altitude*, a *Star* appearing to be of the ſame *Magnitude* that that in *Heaven* appears to be, you may conclude, that that in *Heaven* is a *Planet*. Yet notwithſtanding, it may happen, that a *Planet* may be in the ſame Degree of *Longitude* and *Latitude* in the *Zodiack* that ſome Eminent Fixed *Star* is in, as in the Degree and Minute of *Longitude* and *Latitude*, that *Cor. Leonis*, or the *Bulls Eye*, or *Scorpions Heart* is in, and ſo may Eclipſe that *Star*, by being placed between us and it; but that happens very ſeldom and rarely; but if you doubt it, you may apply your ſelf to ſome other of the precedent and ſubſequent Rules here ſet down, for knowing *Planets* from Fixed *Stars.*

The *Fourth* way, is by ſhifting their Places; for the *Planets* having a continual Motion, do continually Alter their Places, as ♂ moves about half a Degree in a Day, ♀ about a whole Degree; but ♃ and ♄ move very ſlowly; ♃ not moving above 5 Minutes, and ♄ ſeldom above 2 Minutes. Yet by their Motions alone, the *Planets* may be known to be *Planets*, if you will preciſely obſerve their Diſtance from any known Fixed *Star* in or near the *Ecliptick*; as, on this Night, and the next Night after, obſerve whether they retain the ſame Diſtance they had the Night before; which if they do, then are they Fixed *Stars*; but if they do not, then are they *Planets*; yet this Caution is to be given you in this Rule alſo, That the *Planets* ſometime, are ſaid to be *Stationary*, as not altering a Minute in Place, forwards or backwards, in 6 or 7 Days together. Therefore, if you find cauſe to doubt, whether your *Star* be a *Planet*, or a Fixed *Star*, you may, for the Help of your Underſtanding, confer with ſome of the former Rules, unleſs you are willing to wait 8 or 9 Days longer, and ſo by Obſervation of its Motion, reſolve your ſelf. Or,

Fiſthly, You may apply your ſelf to an *Ephemeris* for that Year, and ſee if on that Day you find any *Planet* in the Degree and Minute of the *Zodiack*, you ſee that *Star* you queſtion in *Heaven*, and if there be no *Planet* in that Degree of the *Zodiack*, you may conclude, it is no *Planet*, but a Fixed Star.

PROB. XLV.

How to hang the Terreſtrial Globe *in ſuch a Poſition, that by the* Suns *Shining upon it, you may (with great delight) at once behold the Demonſtration of many Principles in* Aſtronomy *and* Geography.

TAke the *Terreſtrial* Ball out of the *Horizon*, and faſten a Thread on the *Brazen Meridian*, to the Degree of the *Latitude* of your Place; by this Thread hang the *Globe* in a place where the *Suns* Beams may have a free Acceſs to it: Then direct the *Poles* of the *Globe* to their proper *Poles* in *Heaven*, the *North Pole* to the *North*, and the *South Pole* to the *South*; and with a Thread faſtned to either *Pole*, brace the *Globe* ſo, that it do not turn from its Poſition: Then bring your Habitation to the *Meridian*, ſo ſhall your *Terreſtial Globe* be Rectified to correſpond in all reſpects with the *Earth* it ſelf, even as in *Prob.* 44. the *Celeſtial Globe* doth; the *Poles* of the *Globe* to the *Poles* of the *World*, the *Meridian* of the *Globe* to the *Meridian* of the *World*; and the ſeveral Regions on the *Globe* made correſpondent to the ſame Regions on the *Earth*: So that with great delight you may behold,

1. How the counterfeit *Earth* (like the true one,) will have one *Hemiſphere* Sun-ſhine Light, and the other Shadowed, and as it were Dark. By the Lightned *Hemiſphere*, you may ſee that it is Day in all Places that are Situate under it; for on them the *Sun* doth Shine, and that it is Night at the ſame time in thoſe Places

that are Situate in the Shadowed *Hemiſphere*; for on them the *Sun* doth not ſhine; and therefore they remain in Darkneſs.

2. If in the middle of the Enlightned *Hemiſphere*, you ſet a *Sperick Gnomon* Perpendicularly, it will project no Shadow, but ſhews that the *Sun* is juſt in the *Zenith* of that Place; that is, directly over the Heads of the Inhabitants of that Place: And the Point that the *Spherick Gnomon* ſtands on, being removed to the *Meridian*, ſhews the *Declination* of the *Sun* on the *Meridian* for that Day.

3. If you draw a *Meridian* Line from one *Pole* to the other; in all Places under that Line, it is Noon: In thoſe Places Situate to the *Weſt*, it is Morning, for with them the *Sun* is *Eaſt*: And in thoſe Places Situate to the *Eaſt*, it is Evening; for with them the *Sun* is *Weſt*.

4. Note the Degree of the *Equator*, where the Enlightned *Hemiſphere* is parted from the Shadowed; for the Number of Degrees of the *Equator*, intercepted between that Degree and the *Meridian* of any Place converted into Hours, (by accounting for every 15 Degrees 1 Hour,) ſhews, if the *Sun* be *Eaſtwards* of that Place, how long it will be e'er the *Sun* Riſes, Sets, or comes to the *Meridian* of that Place, or if the *Sun* be *Weſtward* of that Place, how long it is ſince the *Sun* Roſe or Set, or was at the *Meridian* of that Place.

5. The Inhabitants of all Places between the Enlightned and Shadowed *Hemiſphere*, behold the *Sun* in the *Horizon*: Thoſe *Weſtwards* of the *Meridian* Semi-Circle drawn through the middle of the Enlightned *Hemiſphere*, behold the *Sun* Riſing: Thoſe is the *Eaſt*, ſee it Setting.

6. So many Degrees as the *Sun* reaches beyond either the *North* or *South Pole*, ſo many Degrees is the *Declination* of the *Sun*, either *Northwards* or *Southwards*: And in all thoſe Places comprehended in a Circle, deſcribed at the Termination of the *Sun-ſhine*, about that *Pole*, it is always Day, till the *Sun* Decreaſe in *Declination*; for the *Sun* goes not Below their *Horizon*, as you may ſee by turning the *Globe* about upon its *Axis*; and in the oppoſite *Pole*, at the ſame Diſtance, the *Sun-ſhine* not reaching thither, it will be always Night, till the *Sun* Decreaſe in *Declination*; becauſe the *Sun* Riſes not above their *Horizon*.

7. If you let the *Globe* hang ſteddy, you may ſee on the *Eaſt*-ſide of the *Globe*, in what Places it grows Night; and on the

Weſt-ſide the *Globe*, how by little and little the *Sun* encroaches upon it; and therefore makes it Day.

8. If you make of Paper or Parchment a narrow Girdle, to begirt the *Globe* juſt in the *Equinoctial*, and divide it into 24 equal Parts, to repreſent the 24 Hours of Day and Night, and mark it in order, with I,II,III, *&c.* to XII. and then begin again with I,II,III, *&c.* to the other XII. you may, by placing one of the XII. upon the *Equinoctial*, under the *Meridian* of your place, have a continual *Sun-Dial* of it, and the Hour of the Day given on it at once in two Places; one by the parting the Enlightned *Hemiſphere* from the Shadowed on the *Eaſtern*-ſide, the other by parting the Enlightned *Hemiſphere* from the Shadowed on the *Weſtern*-ſide the *Globe*. Much more might be ſaid on this Probleme: But the Ingenious Artiſt may, of Himſelf, find our diverſities of Speculations: Therefore I forbear.

PROB. XLVI.

To know by the Terreſtrial Globe *in the* Zenith, *of what Place of the* Earth *the* Sun *is.*

THis may be performed by the former Probleme in the Day-time, if the *Sun* ſhines, but not elſe. But to find it at all times, do thus: Bring the Place for your Habitation to the *Meridian*, and the *Index* of the *Hour-Circle* to 12; Then turn the *Globe Eaſtwards*, if After-noon; or *Weſtwards*, if Before-noon, till the *Index* of the *Hour-Circle* paſs by ſo many Hours from 12, as your Time given is, either Before or After Noon: So ſhall the *Sun* be in the *Zenith* of that Place, where the *Meridian* interſects the *Parallel* of the *Suns Declination* for that Day.

Example.

May 10. at Three Quarters of an Hour paſt 4 a Clock After-noon, I would know in what Place of the *Earth* the *Sun* is in the *Zenith*. My Habitation is *London*; therefore I bring *London* to the *Meridian*, and the *Index* of the *Hour-Circle* to 12. and becauſe it is After-noon, I turn the *Globe Eaſtwards*, till the *Index* paſſes through 4 Hours and 3 Quarters, or (which is all one,) till 70 Degrees 15 Minutes of the *Equator*, paſs through the *Meridian.* Then I find by *Prob.* 5. the *Suns Declination* is 20 Degrees 5 Minutes, which I find upon the *Meridian*, and in that Place, juſt under that Degree and Minute on the *Globe*, the *Sun* is in the *Zenith:* Which in this *Example* is in the *North-Eaſt Cape*, of *Hiſpaniola.*

Having thus found in what Place of the *Earth* the *Sun* is in the *Zenith*, bring that Place to the *Meridian*, and Elevate its reſpective *Pole* according to its reſpective *Elevation*; ſo ſhall all Places cut by the *Horizon* have the *Sun* in their *Horizon.* Thoſe to the *Eaſtwards*, ſhall have the *Sun* Setting; thoſe to the *Weſtwards*, ſhall have it Riſing in their *Horizon*; thoſe at the interſection of the *Meridian* and *Horizon*, under the Elevated *Pole*, have the *Sun* in their *Horizon* at Loweſt, but Riſing; thoſe at the interſection of the *Meridian* and *Horizon*, under the Depreſſed *Pole*, have the *Sun* in their *Horizon* at Higheſt, but Setting. Thus in thoſe Countries that are above the *Horizon*, it is Day-Light, and in thoſe but 18 Degrees below the *Horizon*, it is *Twilight:* But in thoſe Countries further below the *Horizon*, it is at that time dark Night: And thoſe Countries within the *Parallel* of the ſame number of Degrees from the Elevated *Pole*, that the *Suns Declination* is from the *Equinoctial*, have the *Sun* always Above the *Horizon*, till the *Sun* have leſs reſpective *Declination* than the Elevated *Pole*; and thoſe within the ſame *Parallel* of the Depreſſed *Pole*, have the *Sun* always Below their *Horizon*, till the *Sun* inclines more towards the Depreſſed *Pole*; as you may ſee by turning about the *Globe*; for in this Poſition, that Portion of the *Globe*, intercepted between the Elevated *Pole*, and the *Parallel* Circle of 20 Degrees 5 Minutes from the *Pole*, doth not Deſcend below the *Horizon:* Neither doth that Portion of the *Globe*, intercepted between the Depreſſed *Pole* and the *Parallel* Circle, within 20 Degrees 5 Minutes of that *Pole*, Aſcend above the *Horizon.*

PROB. XLVII.

To find in what different Places of the Earth, *the* Sun *hath the ſame* Altitude *at the ſame Time.*

FInd by the former Probleme, in what Place of the *Earth* the *Sun* is in the *Zenith*, and bring that Place on the *Globe*

Globe to the *Zenith*,and on the *Meridian*(there)ſcrew the *Quadrant of Altitude*, and turn it about the *Horizon*, deſcribing Degrees of *Almicantars* thereby, as by *Prob.* 23. and all thoſe Countries in any *Almicantar* on the *Globe*, ſhall have the *Sun* Elevated the ſame number of Degrees above their *Horizon.* Thus thoſe Countries in the tenth *Almicantar*, ſhall have the *Sun* Elevated 10 Degrees above their *Horizon*; thoſe in the 20th *Almicantar*,ſhall have the *Sun* Elevated 20 Degrees above their *Horizon*; thoſe in the 30th, 30 Degrees.*&c.* So that you may ſee, when the *Sun* is in the *Zenith* of any Place, all the Countries or Cities in one and the ſame *Almicantar*, have the *Sun* in one Height at the ſame time above their *Horizon.* But to find in what different Places the *Sun* hath the ſame Height at the ſame time, as well Before or After Noon, as at Full Noon; and that in Countries that have Greater *Latitude* than the *Suns* greateſt *Declination*, (and therefore cannot have the *Sun* in their *Zenith*,) requires another Operation.

Therefore, Elevate its reſpective *Pole* according to your reſpective *Latitude*; and let the Degree of the *Brazen Meridian* which is in the *Zenith*, repreſent your Habitation, and the Degree of the *Ecliptick* the *Sun* is in,repreſent the *Sun.*Then bring the *Sun* to the *Meridian*,and the *Index* of the *Hour-Circle* to 12, and turn the *Globe Eaſtwards*, if Before Noon; or *Weſtwards*, if After Noon, till the *Index* point to the Hour of the Day; then place the lower end of the *Quadrant of Altitude*, to the *Eaſt*-point of the *Horizon*, and move the upper-end (by ſliding the Nut over the *Meridian*,)till the Edge of the *Quadrant* touch the place of the *Sun:* Then ſee at what Degree of the *Meridian*,the upper-end of the *Quadrant of Altitude* touches the *Meridian*, and Subtract that Number of Degrees from the *Latitude* of your Place, and count the Number of Remaining Degrees on the *Meridian*; on the contrary-ſide, the Degree of the *Meridian*,where the upper-end of the *Quadrant of Altitude* touches the *Meridian*; and where that Number of Degrees ends on the *Meridian* in that *Latitude*, and your Habitations *Longitude*, hath the *Sun* the ſame Height at the ſame time.

Example.

May 10. at 53 Minutes paſt 8 a Clock in the Morning, I would know, in what Place the *Sun* ſhall have the ſame *Altitude* it ſhall have at *London*. *London*s *Latitude* found by Prob. 1. is 51½ Degrees *Northwards*: And becauſe the Elevation of the *Pole* is equal to the *Latitude* of the Place. (as was ſhewed Prob. 15.) therefore I Elevated the *North Pole* 51½ Degrees; ſo ſhall 51½ Degrees on the *Meridian*, be in the *Zenith*: This 51½ Degrees on the *Meridian* repreſents *London*. The *Suns* place found by Prob. 3. is ♉ 29. Therefore I bring ♉ 29 to the *Meridian*, and the *Hour-Index* to 12 on the *Hour-Circle*: Then I turn the *Globe Eaſtwards* (becauſe it is Before noon,) till the *Index* point at 8 Hours 53 Minutes in the *Hour-Circle*, and place the lower end of the *Quadrant of Altitude* to the *Eaſt*-point in the *Horizon*, and ſlide the upper end either *North* or *Southwards* on the *Meridian*, till the graduated Edge cut the Degree of the *Ecliptick* the *Sun* is in. Then I examine on the *Meridian*, what Degree the upper-end of the *Quadrant of Altitude* touches; which in this *Example*, I find is 28 Degrees: Therefore I ſubtract 28 from 51½ *London*'s *Latitude* and there remains 23½. Then counting on the *Meridian* 23½ Degrees backwards, from the Point where the *Quadrant of Altitude* touched the *Meridian*, I come to 4 Degrees on the *Meridian*, *Northwards*. Therefore I ſay, in the *North Latitude* of 4 Degrees, and in the *Longitude* of *London* (which is about C. *Apolonia*, on the Coaſt of *Guinea*,) the *Sun* *May* 10. at 53 Min. paſt 8 a Clock in the Morning, hath the ſame *Altitude* above the *Horizon* it hath here at *London*.

The *Quadrant of Altitude* thus applied to the *Eaſt*-point of the *Horizon*, makes Right Angles with all Points on the *Meridian*, even as all the *Meridians* proceeding from the *Pole*, do with the *Equator*. Becauſe the *Eaſt*-point of *Horizon* is here made the Centre or *Pole* of the Plain of the *Meridian*: Therefore the *Quadrant* being applied both to the *Eaſt*-point and the *Suns* Place, projects a Line to interſect the *Meridian* in the Middle-point, between the *Latitude* of your Habitation, and the *Latitude* of that Place, in which the *Sun* ſhall have the ſame *Altitude* it hath at your Habitation at the ſame time. Thus it falls out, that thoſe that Inhabit 5 Deg. to the *Northwards* of this interſection, have the *Sun* the ſame Height that they have that Inhabit 5 Deg. to the Southwards of it: And thoſe 10, 20, 30 Deg. more or leſs, to the *Northwards*, have the *Sun* in the ſame Height that they have, that are 10, 20, 30. Deg. more or leſs, to the *Southwards*: So that this Prob. may be done yet eaſier with your *Compaſſes*, thus: The *Globe* and *Hour-Index* Rectified; turn about the *Globe* till the *Hour-Index* point to the Hour of the Day: Then pitch one Foot of your Compaſſes in the *Suns* Place, and extend the other to the Degree of *Latitude* on the *Meridian*, which in this *Example*, is $51\frac{1}{2}$ Degrees *North*, then keeping the firſt Foot of your *Compaſſes* on the Degree of the *Sun*, turn about the other Foot to the *Meridian*, and it will fall upon 4, as before.

By this Probleme you may take notice, how groſly they err, that think they can find the Height of the *Pole* at any Hour of the Day, by the *Suns* Height: Becauſe they do not conſider, that it is impoſſible to find the Hour of the Day, unleſs they firſt know the Height of the *Pole*.

PROB. XLVIII.

To find the Length of the Longeſt and Shorteſt Artificial Day or Night.

THE Artificial Day, is that ſpace of Time which the *Sun* is above the *Horizon* of any Place; and the Artificial Night, is that ſpace of Time which the *Sun* is under the *Horizon* of any Place. They are Meaſured in the *Hour-Circle*, by Hours and Minutes.

There is a conſtant and unequal diſproportion in the Length of theſe Days and Nights; which is cauſed both by the Alteration of the *Suns Declination*, and the difference of the *Poles Elevation*.

Thoſe that Inhabit on the *North*-ſide the *Equator*, have their Longeſt Day, when the *Sun* enters *Cancer*; and thoſe that Inhabit on the *South*-ſide the *Equator*, have their Longeſt Day when the *Sun* enters *Capricorn*. But to know how long the Longeſt Day is in any *North* or *South* Elevation, raiſe the *North* or *South Pole*, according to the Elevation of the Place, and bring *Cancer* for *North* Elevation, or *Capricorn* for *South* Elevation, to the *Meridian*, and the *Index* of the *Hour-Circle* to 12. Then turn the *Globe* about, till *Cancer* for *North*, or *Capricorn* for *South* Elevation come to the *Weſt*-ſide the *Horizon*, and the number of Hours and Minutes pointed at on the Hour-Circle doubled, is the number of Hours and Minutes of the Longeſt Day.

The Length of the Night to that Day, is found by Subtracting the Length of the Day from 24, for the Remainder is the length of the Night.

The ſhorteſt Day in that *Latiude*, is the length of the ſhorteſt Night, found as before. And the longeſt Night, is of the ſame length with the longeſt Day.

Example.

I would know the length of the longeſt Day at *London.* Therefore I Elevate the *North Pole* 51 ½ Degrees, and bring ♋ to the *Meridian*, and the *Index* of the *Hour-Circle* to 12. Then I turn ♋ to the *Weſtern*-ſide the *Horizon*, and find the *Index* point at 8 Hours 18 Minutes; which being Doubled, makes 16 Hours 36 Minutes, for the length of the longeſt Day here at *London.*

PROB. XLIX.

To find how much the Pole *is* Raiſed *or* Depreſſed, *where the Longeſt Day is an Hour Longer or Shorter than it is in your Habitation.*

Rectifie the *Globe* to the *Latitude* of your Place, and make a Prick at that Point of the *Troprick*, which is at the *Meridian*; I mean at the *Troprick* of *Cancer*, if your Habitation be on the *North*-ſide the *Equator*, or ♑ if your Habitation be on the *South*-ſide the *Equator*. And if you would know where the longeſt Day is juſt an Hour longer than it is at your Habitation, turn the *Globe* to the *Weſtward*, till 7 ½ Degrees of the *Equator* paſs through the *Meridian*, and make there another Prick on the *Troprick*; then turn about the *Globe* till the firſt Prick come to the *Horizon*; and move the *Meridian* through the Notches of the *Horizon*, till the ſecond Prick on the *Troprick* come to the *Horizon*; ſo ſhall the Arch of the *Meridian*, contained between the Elevation of your Place, and the Degree of the *Meridian* at the *Horizon*, be the number of Degrees that the *Pole* is Elevated Higher than it is in your *Latitude*.

Example.

I would know in what *Latitude*, the longeſt Day is an Hour longer than it is at *London*. Therefore, I Rectifie the *Globe* to 5½ Deg. and where the *Meridian* cuts the *Troprick* of ♋ I make a Prick; then I note what degree of the *Equator* is at the *Meridian*, and from that degree on the *Equator* count 7½ degrees to the Eaſtwards, and bring thoſe 7½ degrees to the *Meridian* alſo; and again, where the *Meridian* cuts the *Tropick* of ♋ I make no other Prick, ſo ſhall 7½ degrees of the *Tropick* be contained between thoſe two Pricks: Then I turn the *Globe* about, till the Firſt Prick comes to the *Horizon*, and (with a Quill, thruſt between the *Meridian* and the Ball) I faſten the *Globe* in this Poſition: Afterwards I move the *Meridian* through the Notches of the *Horizon*, till the Second Prick Riſes up to the *Horizon*, and then I find 56½ degrees of the *Meridian* cut by the Superficies of the *Horizon:* Therefore I ſay, in the *Latitude* of 56½ degrees, the longeſt day is an Hour longer than it is here at *London*.

But if you would know in what Latitude the days are an Hour Shorter, you muſt make your Second Prick 7½ degrees to the *Weſtwards* of the Firſt, and after you have brought the Firſt Prick to the *Horizon*, you muſt depreſs the Pole, till the Second Prick deſcends to the *Horizon*; ſo ſhall the degree of of the *Meridian* at the *Horizon*, ſhew in what Elevation of the *Pole* the days ſhall be an Hour ſhorter.

By this Probleme may be found the Alteration of Climates: For (as was ſaid in the definition of *Climates*, *Book* 1. *Fol.* 28.) Climates alter according to the Half-Hourly increaſing of the longeſt day; therefore the Latitude of 56½ degrees (having its days increaſed an whole Hour) is diſtant from the Latitude of *London*, by the Space of two Climates.

PROB. L.

The Suns *Place given, to find what Alteration of* Declination *it muſt have, to make the Day an Hour Longer or Shorter; and in what Number of Days it will be.*

REctifie the *Globe* to the Latitude of the Place, and bring the *Sun*'s Place to the Eaſt ſide the *Horizon*, and note againſt what degree of the *Horizon* it is: Then bring one of the *Colures* to interſect the *Horizon* in that degree of the *Horizon*, and at the Point of Interſection make a Prick in the *Colure*; and obſerve what degree of the *Equator* is then at the *Meridian:* Then turn the *Globe* Weſtwards, if the days ſhorten, but Eaſtwards, if they Lengthen till 7 ½ Degrees of the *Equator* paſs through the *Meridian*, and where the *Horizon* interſects the ſame *Colure*; make another Prick in the *Colure*: Afterwards bring the *Colure* to the *Meridian*, and count the number of Degrees between the two Pricks; for ſo many Degrees muſt the *Suns Declination* Alter, to Lengthen or Shorten the Day and Hour.

Example.

The *Suns* Place is ♉ 10. I would know how much he muſt alter his *Declination* before the Day is an Hour longer here at *London*. Therefore I Rectifie the *Globe* to the *Latitude* of *Lond.* and bring 10. to the *Eaſt* ſide the Horizon, and find it againſt 24 ½ Degrees from the *Eaſt*-point: Therefore I bring one of the *Colures* to this 24 ½ Degrees, and cloſe by the Edge of the *Horizon*; I make a Prick with Black Lead, in the *Colure*: Then keeping the *Globe* in this Poſition, I look what Deg. of the *Equator* is then at the *Meridian*, and find 250. 15. And becauſe the Days Lengthen, I turn the *Globe Eaſtwards*, till 7 ½ Degrees from the aforeſaid 250. 15. paſs through the *Meridian*: Then keeping the *Globe* in this Poſition, I make another Prick in the *Colure*; and bringing this *Colure* to the *Meridian*, I find a little more than 5 deg. of the *Meridian*, contained between the two Pricks: Therefore, I ſay, when the *Sun* is in ♉ 10 degrees, he muſt alter his *Declination* a little more than 5 degrees, to make the Day an Hour Longer.

Now to know in what number of Days he ſhall alter this *Declination*, you muſt find the *Declination* of the two Pricks on the *Colure*, as you found the *Suns Declination* by Prob. 5. and the Arch of the *Ecliptick* that paſſes through the *Meridian*, while the *Globe* is turned from the Firſt Pricks *Declination* to the Second Pricks *Declination*, is the number of the *Ecliptical* degrees that the *Sun* is to paſs, while he alters this *Declination*; and the deg. of the *Ecliptick* then at the *Meridian*, is (with reſpect had to the Quarter of the Year,) the Place the *Sun* ſhall have when its *Declination* ſhall be altered, ſo much as to make the Day an Hour Longer.

Thus having the *Suns* firſt Place given, and its Second Place found, you may by finding thoſe two Places on the Plain of the *Horizon*, alſo find the number of Days comprehended between them, as you are taught by the fourth Probleme.

This Probleme thus wrought for different Times of the Year, will ſhew the Fallacy of that Vulgar Rule, which makes the Day to be Lengthned or Shortned an Hour in every Fifteen Days; when as the Lengthning or Shortning of Days keep no ſuch Equality of Proportion: For when the *Sun* is near the *Equinoctial* Points, the Days Lengthen or Shorten very faſt; but when he is near the *Tropical* Points, very ſlowly.

PROB. LI.

Of the Difference of Civil *and* Natural Days, *commonly called the* Equation *of* Civil Days. *And how it may be found by the* Globe.

THE *Civil Day*, is that ſpace of Time containing juſt 24 Hours, reckoned from 12 a Clock on one Day to 12 a Clock the next Day; in which ſpace of Time, the *Equinoctial* makes upon the *Poles* of the *World* a Diurnal Revolution. The *Natural Day*, is that ſpace of Time wherein the *Sun* moveth from the *Meridian* of any Place to the ſame *Meridian* again. Theſe Days are at one Time of the Year Longer than at another; and at all times Longer than the *Civil Days*. There is but ſmall diſcrepancy between them, yet ſome there is, made by a twofold Cauſe. For Firſt, The *Suns* Apparent Motion is different from his true Motion; He being much Slower in his *Apogeum*, than he is in his *Perigeum*: For when the *Sun* is in his *Apogeum*, he ſcarce Moves 58 Minutes from *Weſt* to *Eaſt* in a *Civil Day*, but when he is in his *Perigeum*, he moves above 61 Minutes in a *Civil Day*: And therefore increaſes his *Right Aſcenſion* more in equal Time.

The Second Cauſe is the difference of *Right Aſcenſion* anſwerable to equal Parts of the *Ecliptick*: for about ♋ and ♑ the differences of *Right Aſcenſions* are far greater than about ♈ and ♎; for about ♈ and ♎ the *Right Aſcenſion* of 10 deg. is but 9 Degrees 11 Minutes; but about ♋ and ♑, the *Right Aſcenſion* of 10 Degrees, will be found to be 10 Degrees 53 Minutes; as by the *Globe* will appear.

But becauſe of the ſmallneſs of the *Globes* Graduation, you cannot actually diſtinguiſh to Parts near enough for the Solution of this Probleme, if you would enquire the difference in Length of two ſingle Days; therefore it will be requiſite to take ſome ber of Days together; ſuppoſe 20. Therefore find by *Prob.* 3. the Places of the *Sun*, from the beginning and ending of thoſe Days you would compare; and find the *Right Aſcenſion* anſwerable to each Place in the *Ecliptick*; and alſo the Differences of *Right Aſcenſions*, anſwerable to the *Sun*'s Motion, in each number of Days: Then compare the Differences of *Right Aſcenſions* together; and by Subtracting the Leſſer from the Greater, you will have the number of Degrees and Minutes of the *Equator*, that have paſſed thro' the *Meridian*, more in one number of Days, than in the other number of Days: Which degrees of the *Equator* converted into *Time*, is the number of Minutes, that the one number of days is longer than the other number of days.

Example.

I would know what difference of Time there is in the Length of the firſt 20 days of *December*, and the firſt 20 days of *March*. I find by *Prob.* 3. the *Sun*'s Place, *December* 1. is ♐ 19.45. at the end of 20 days, *viz.* on the 21 day his Place is ♑ 10.11. The *Sun*'s Place, *March* 1. is ♓ 21.26, at the 20 days end, *viz.* *March* 21. his Place is ♈ 11.3.

I find by *Prob.*26. the *Right Aſcenſion* anſwerable to	♐ 19.45	is	258.10.
	♑ 10.11		280.25.
	♓ 21.16		352.00.
	♈ 11. 3		9.40.

and the difference of *Right Aſcenſions* contained between the firſt day in each Month, and the 21 of the ſame Month, by Subtracting the Leſſer from the Greater is, for

258.10.	And for	352.00.
280.25.		9.40.
22.15.		17.40.

But note, becauſe the *Vernal Colure* (where the degrees of *Right Aſcenſion* begin and end their Account) is intercepted in the Arch of the *Sun*'s Motion, from the firſt to the 21 of *March*. Therefore inſtead of Subtracting the leſſer number of degrees of *Right Aſcenſion* from the Greater, *viz.* 9.40. from 352. I do for finding the difference of the *Aſcenſional Arch* of the *Sun*'s Motion in thoſe 20 days, Subtract the aforeſaid 352. degrees from 360, and the Remains is 8. which is the difference of *Right Aſcenſion* from ♓ 21.16. to the *Equinoctial Colure*: To which 8, adding 9 Degrees 40 Minutes, the *Right Aſcenſion* from the *Equinoctial Colure*, to ♈ 11.3. it makes 17 Degrees 40 Minutes for the Difference of *Right Aſcenſions* between ♓ 21.16. and ♈ 11.3. Then I find the Difference of this Difference of *Right Aſcenſion*, by Subtracting the Leſs from the Greater, *viz.* 17.40. from 22.15. and the Remains is 4 Degrees 35 Minutes, for the number of Degrees and Minutes of the *Equator*, that paſs thro' the *Meridian* in the firſt 20 Days, in the Month of *December*, more than in the firſt 20 Days of the Month of *March*, which 4 Degrees 35 Minutes, converted into *Time*, gives 19 Minutes, that is, a Quarter of an Hour, and 4 Minutes, that the firſt 20 Days of *December* aforeſaid, are longer than the firſt 20 Days of *March*.

PROB. LII.

How to find the Hour of the Night, when the Moon *Shines on a* Sun-Dial, *by help of the* Globe.

Rectifie the *Globe*, and find by *Prob.* 54. or an *Ephemeris*, the Moons Place at Noon: Bring it to the *Meridian*, and the *Index* of the *Hour-Circle* to 12, and turn about the *Globe*, till the *Index* of the *Hour-Circle* points to the ſame Hour, the Shade of the Moon falls on the *Sun-Dial*. Then by *Prob.* 3. find the *Sun*'s Place at Noon, and ſee how many Degrees of *Right Aſcenſion* are contained between the *Sun*'s Place, and the degree of the *Equator* at the *Meridian*, when the *Index* of the *Hour Circle* is brought to the Hour the Moon Shines on in the *Sun-Dial*; for thoſe number of Degrees, converted into Time, ſhall be the Time from Noon, or the Hour of the Night. Only note, Reſpect muſt be had to the Motion of the Moon, from *Weſt* to *Eaſt*; for ſo Swift is her Mean Motion, that it is accounted to be above 12 Degrees in 24 Hours; that is, 6 Degrees in 12 Hours, 3 Deg. in 6 Hours, *&c.* and this alſo converted into Time, as aforeſaid, you muſt add proportionably to the Time found from Noon; and the Sum ſhall give you the true Hour of the Night.

Example.

Here at *London* I deſire to know the Hour of the Night, *January* 6. this preſent Year 1658. The *Moons* Place found by an *Ephemeris*, or for want of an *Ephemeris*, by Prob. 54. is in ♊ 21 Degrees 22 Minutes; therefore I rectified the *Globe* to *London's Latitude*, and brought ♊ 21. 22. Minutes to the *Meridian*, and the *Index* of the *Hour-Circle* to 12. then by Prob. 3. I found the *Suns* Place in ♑ 26 Degrees 46 Minutes, and by Prob. 26. I found his *Right Aſcenſion* to be 300 Degrees; then I turned about the *Globe* till the *Index* of the *Hour-Circle* pointed at 10 Hours, and at the Degree of the *Equator* at the *Meridian*, I made a Prick; then I accounted the number of Degrees of the *Equator*, contained between the foreſaid 300 Deg. and this Prick, and found them $111\frac{1}{4}$ Degrees, which converted into *Time*, by allowing 15 Degrees for an Hour, give 7 Hours 25 Minutes Time for Noon; which if the *Moons* Motion were not to be conſidered, ſhould be the immediate Hour of the Night: But by the Rule aforeſaid, the *Moons* Motion from *Weſt* to *Eaſt*, in 7 Hours 25 Minutes, is 3 Degrees 42 Minutes: And this 3 Degrees 42 Minutes being converted into *Time*, is 14 *Minutes* more, which being added to 7 Hours 25 Minutes, make 7 Hours 39 Minutes, for the true Hour of the Night.

PROB. LIII.

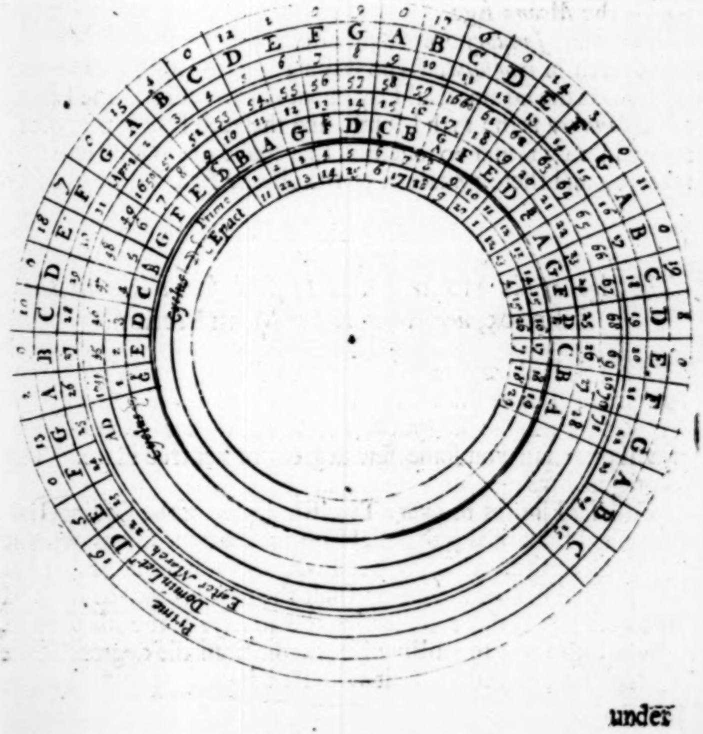
To find the Dominical Letter, *the* Prime Epact, Eaſter Day, *and the reſt of the* Moveable Feaſts, *for ever.*

THough theſe Problemes cannot be performed by the *Globe*, becauſe of the ſeveral Changes, and irregular Accounts that their Rules are framed upon; yet, becauſe they are of frequent and Vulgar Uſe, and for that the Solution of many other Queſtions, will have dependency on the knowledge of theſe, therefore I have thought fit here to inſert this *Table* of Mr. *Palmer's*, by which you may find them all.

I ſhall not inſiſt upon the Reaſons of the ſeveral Changes of Letters, and Numbers, Himſelf having already very learnedly handled that Subject, in his Book of the *Catholick Planiſphere*, *Book* 1. *Chapter* 11. (to which I refer you;) neither ſhall I need to give you any other Inſtructions for finding what is here propoſed, than what himſelf hath given in his Fourth *Book*, *Chapter* 66, and part of 67. therefore take it as he there delivers it.

An *Example* ſhall ſerve here inſtead of a *Rule*. For the Year 1657. I would know all theſe: Wherefore I ſeek the Year 1657. in the Table of the *Suns Cycle*, and over againſt it, find 14 for the Year of the *Cycle of the Sun*, and D for the *Dominical Letter*. And note here, that every *Leap-Year* hath 2 *Dominical Letters* (as 1660 hath A G) and the Firſt (*viz.* A) ſerveth that Year till *February* 25, and the Second (G) for the reſt of the Year. And note, that theſe Letters go always backwards, when when you count forwards (as B A, then G F, *&c.* not F G, and then A B,) as you may ſee by the Table.

Then in the Table of the *Cycle of the Moon*, I have for the Year 1657. the *Prime* 5. the *Epact*. 25. Thoſe had, I go to the Table for *Eaſter*, and ſeek there in the firſt Rank the *Prime* 5. and



under it in the middle Rank ſtands E; that is not my Dominical Letter, therefore I ſeek not backward, but always forward in the middle Rank, till I come to my Dominical Letter D, and under it I find in the third Rank, *March* 29. upon which *Eaſter-Day* falls this Year 1657. The reſt of the *Moveable Feaſts* may be had by their diſtances from *Eaſter*, which are always the ſame. Only for *Advent-Sunday* remember, that the next *Sunday* after *November* 26. is *Advent-Sunday*. Read *Book* 1. 11. and that will ſufficiently inſtruct you with this *Example*.

To find the Age of the Moon.

Remember firſt, that the Epact begins with *March*, which muſt be here accounted the firſt Month: Then if you add to the Epact the number of the Month Current, and the number of the Day of the Month Current, the Sum, or the Exceſs above 30, is the *Moons* Age.

Example, *January* 20. 1656. According to the Account of the Church of *England*, (who begin the Year with *March* 25. which was the Equinoctial Day, about Chriſt's Time) the Epact is 14 *January*, is the 11th Month, and the 20th Day is propoſed; now add 14, 11, and 20 together, they make 45, out of which I take 30, and there remains 15, the *Moons* Age.

PROB. LIV.

The Age of the Moon, *given to find her Place in the* Eclipticк, *according to her* Mean Motion.

THIS Probleme may be performed exact enough for common Uſes by the *Globe*; but in regard it only ſhews the *Moons* Place in the Ecliptick, according to her Mean Motion, it will often fail you ſome few degrees of her true Place. The Work is thus;

Firſt ſet Figures to every Twelfth degree of the Equinoctial, accounted from the Equinoctial Colure, marking them with 1, 2, 3, 4, *&c.* to 30. which will end where you began, *viz.* at the Equinoctial Colure again; ſo ſhall the Equinoctial be divided into 30 equal Parts, repreſenting the 30 days of the *Moons* Age. Theſe Figures (to diſtinguiſh them from the degrees of the *Equator*) were beſt be writ with Red Ink.

When you would enquire the *Moons* Place, Elevate the *North Pole* 90 Degrees, that is, in the *Zenith*, ſo ſhall the *Equator* lye in the *Horizon:* Then bring the *Equinoctial Colure* againſt the Day of the Month in the *Horizon*, ſo ſhall the *Moons* Age written in Red Figures, ſtand againſt the Sign and Degree in the *Horizon* that the *Moon* is in at that Time.

Example.

September 28. 1658. I would know the *Moons* Place in the *Ecliptick*, She being then 12 Days Old. Therefore I Elevate the *North Pole* 90 Degrees above the *Horizon*, and turn the *Globe* about till the *Equinoctial Colure* come to *September* 28. in the Circle of Days on the *Horizon*; then looking againſt what *Sign* and Degree of the *Ecliptick* Circle in the *Horizon* the 12th diviſion in Red Figures ſtands, I find ♓ *9.* which is the *Sign* and Degree the *Moon* is in, according to her *Mean Motion.*

This Probleme may be applied to many Uſes: For having the *Moons* Place, you may find the Time of her *Riſing*, *Southing*, *Setting*, and *Shining*, &c. by working with Her, as you were taught to work with the *Sun*, in ſeveral foregoing Problemes, proper to each purpoſe.

PROB. LV.

Having the Longitude *and* Latitude, *or* Right Aſcenſion *and* Declination *of any* Planet, *or* Comet, *to place it on the* Globe, *to correſpond with its place in* Heaven.

PLanets and *Comets* cannot be placed on the *Globe* ſo as their Places will long retain correſpondence with their Places in *Heaven*; Becauſe, as was ſaid, Chap. 44. they have a continual Motion from *Weſt* to *Eaſt* upon the *Poles* of the *Ecliptick:* Yet nevertheleſs, you may, by having their *Longitude* and *Latitude*, or *Right Aſcenſion* and *Declination*, for any ſet Time, place a Mark for them on the *Globe*, either with Ink, if your *Globe* be Varniſht, for then you may with a wet Finger wipe it off again; or with Black-lead, if it be not Varniſht, and then you may rub it out again with a little White

Bread : Which Mark for that Time, will as effectually ſerve you to work by, as any of the Fixed *Stars* placed on the *Globe* will do.

Therefore if the *Longitude* and *Latitude* of any *Planet* or *Comet* be given; do thus, Elevate the *North Pole* if the *Latitude* given be *North*; but if the *Latitude* given be *South*, Elevate the *South Pole*, 66½ Degrees; and place the *Pole* of the *Ecliptick* in the *Zenith*, and over it ſcrew the *Quadrant of Altitude:* So ſhall the *Ecliptick* lye in the *Horizon*; and the *Quadrant of Altitude* being turned about the *Horizon*, ſhall paſs through all the Degrees of *Longitude*; Then find the point of given *Longitude* in the *Ecliptick*, and bring it to the *Quadrant of Altitude*, and hold it there: Then count upwards on the *Quadrant of Altitude*, the number of Degrees and Minutes of Given *Latitude*, and at the point where the number ends cloſe to the *Quadrant of Altitude*, make a ſmall Prick, and that Prick ſhall repreſent the *Planet* or *Comet* you were to place on the *Globe*.

If it be the *Right Aſcenſion* and *Declination* of a *Planet* or *Comet* that is given; you muſt find the Degree and Minute of *Right Aſcenſion* on the *Equinoctial*, and bring it to the *Meridian*, and keep the *Globe* there ſteddy; then find the Degree and Minute of *Declination* on the *Meridian*, and under that Degree and Minute on the *Globe*, make a Prick, and that Prick ſhall repreſent the *Planet* or *Comet*, as aforeſaid.

If it be ♄ or ♃ that this Prick is to repreſent, it may ſtand on the *Globe* ſometimes a Week or a Fortnight, without much difference from the *Planets* place in Heaven. But if the Prick were to repreſent the other *Planets*, you muſt (in regard of their Swift Motion) alter it very often, eſpecially for the *Moon*; for ſo Swift is her Motion, that in every Two Hours ſhe Alters about a Degree in *Longitude*.

Having thus placed this Mark on the *Globe*, you may find out the Time of its ſeveral Poſitions and Aſpects, if you work by it as you are directed to work by the *Sun*, in the ſeveral reſpective Problemes throughout this Book.

The End of the Second Book.

The Third BOOK.

Being the Practical Uſe of the

GLOBES.

Applied to the Solution of *PROBLEMES* IN THE

Art of Navigation.

PRÆFACE.

B*Ecauſe the Art of* Navigation *conſiſts as well in the knowledge of* Aſtronomical *and* Geographical Problemes, *as in Problemes meerly* Nautical; *Therefore I muſt deſire the Artiſt to ſeek in the laſt Book ſuch Problemes as are only* Aſtronomical *or* Geographical: *For my Deſign is here to collect ſuch Problemes as are only uſed in the Art of* Navigation: *Some few particulars excepted, as for finding* Latitude, Longitude, Courſe, Diſtance, *&c. Which though they are handled in that Book; yet for their Utility in the Art of* Navigation, *and for that what there is Given, cannot always be had to Work by; therefore in this Book I have mention'd divers other* Obſervations, *which being Made or Had, you may by the Rules proper for each* Obſervation, *Find what ſhall be Propoſed.*

PROB. I.

The Suns Amplitude *and* Difference *of* Aſcenſion *given, to find the* Height *of the* Pole, *and* Declination *of the* Sun.

ELevate the *Pole* ſo many Degrees as the Difference of the *Suns Aſcenſion* is, and ſcrew the *Quadrant of Altitude* to the *Zenith*, and bring the firſt point of ♈ to the *Meridian*; then number on the *Quadrant of Altitude* upwards the Complement to 90 of the *Suns Amplitude*, and move the *Quadrant of Altitude* till that number of Degrees cuts the *Equator*; So ſhall the *Quadrant* cut in the *Horizon* the Degree of the *Poles Elevation*; and in the *Equator* the Degree of the *Suns Declination*.

Example.

The Difference of *Aſcenſion* is 27 Degrees 7 Minutes. Therefore I Elevate the Pole 27 Degrees 7 Minutes Above the *Horizon*, and ſcrew the *Quadrant of Altitude* to 27 Degrees 7 Minutes, which is in the *Zenith:* Then I bring the firſt point of ♈ to the *Meridian*, and number on the *Quadrant of Altitude* upwards 56 Degrees 40 Minutes, the Complement of the *Suns Amplitude*, and bring that Degree to the *Equator:* Then I ſee in what Degree of the *Horizon* the *Quadrant* cuts the *Horizon*, and find $51\frac{1}{2}$, which is the *Elevation* of the *Pole:* Then looking in what Degree of the *Equator* the *Quadrant of Altitude* cuts the *Equator*, I find 20 Degrees 5 Minutes, which is the *Declination* of the *Sun* at the ſame Time.

PROB. II.

The Suns Declination *and* Amplitude *given, to find the* Poles Elevation.

ELevate the Pole ſo many Degrees as the Complement of the *Suns Altitude* is; and ſcrew the *Quadrant of Altitude* in the *Zenith*, and bring the firſt point of ♈ to the *Meridian*: Then count on the *Quadrant of Altitude* to the Degree of the *Suns Declination*, and bring that Degree to the *Equinoctial*; and the Degree of the *Equinoctial*, cut by that Degree of the *Quadrant of Altitude*, is the Degree of the *Poles Elevation*.

Example.

The *Suns Amplitude* is 33 Degrees 20 Minutes, his *Declination* is 20 Degrees 5 Minutes, his Complement of *Amplitude* to 90 is 56 Degrees 7 Minutes. Therefore I Elevate the *Pole* 56 Degrees 7 Minutes Above the *Horizon*, and ſcrew the *Quadrant of Altitude* to 56 Degrees 7 Minutes, which is in the *Zenith*: Then I bring the firſt point of ♈ to the *Meridian*, and number on the *Quadrant of Altitude* Upward 20 Degrees 5 Minutes for the *Suns Declination*, this 20 Degrees 5 Minutes, I bring to the *Equinoctial*, and find it cut there 51$\frac{1}{2}$ Degrees, for the *Height* of the *Pole*.

PROB. III.

The Suns Declination *and* Hour *at* Eaſt *given, to find the* Height *of the* Pole.

Elevate the *Pole* ſo many Degrees as the *Suns Declination* is, and ſcrew the *Quadrant of Altitude* in the *Zenith*: Then Convert the Hours or Minutes paſt *6* given into Degrees, by allowing 15 Degrees for every Hour of *Time*, and for every Minute of *Time* 15 Minutes of a Degree; and number thoſe Degrees or Minutes in the *Horizon* from the *Eaſt Southwards*; and bring the *Quadrant of Altitude* to that Degree, ſo ſhall the Degree of the *Quadrant of Altitude* cut by the *Equator*, be the Complement of the *Height of the Pole*.

Example.

The *Suns Declination* is 20 Degrees 5 Minutes; therefore I Elevate the *Pole* 20 Degrees 5 Minutes, and alſo ſcrew the *Quadrant of Altitude* to 20 Degr. 5 Min. whieh is in the *Zenith*: The Hour the *Sun* comes to be at *Eaſt* is 7 a Clock 7 Minutes, that is, 1 Hour 7 Minutes after *6*. Therefore I convert 1 Hour 7 nutes into Degrees, as before, and it gives 16 Degrees 50 Minutes; which number of Degrees and Minutes I count from the *Eaſt* point *Southwards*, and thither I bring the *Quadrant of Altitude:* Then I look in what Degree of the *Quadrant of Altitude* the *Equator* cuts, and find 38½, which is the *Complement of the Pole Height*, *viz* 51½ Degrees for the *Height of the Pole.*

In this Probleme, the *Declination* of the *Sun*, and Elevation of the *Pole*, bears the ſame Denomination of either *North* or *South*, for when the *Declination* and the Elevation are Different, the *Sun* cannot come to the *Eaſt* point.

PROB. IV.

The Declination *of the* Sun, *and his* Altitude *at* Eaſt *given, to find the* Height *of the* Pole.

ELevate the *Pole* to the Complement of the *Suns Altitude*, and ſcrew the *Quadrant of Altitude* to the *Zenith:* Then bring the *Equinoctial* point ♈ to the *Meridian*, and number on the *Quadrant of Altitude* the Degree of the *Suns Declination*, and bring that Degree to the *Equinoctial*, and note the Degree it Cuts; for its Complement to 90 is the *Height of the Pole.*

Example.

May 10. The *Suns Declinaion* is 20 Degrees 5 Minutes; His *Altitude* at *Eaſt* is 25 Degrees 55 Minutes here at *London:* I enquire the *Height of the Pole.* Therefore I ſubtract 25 Deg. 55 Min. from 90, the Remains is 64 Deg. 5 Min. for its Complement, wherefore I bring 64 Deg. 5 Min. of the *Meridian* to the *Horizon*; and to 64 Deg. 5 Min. which is the *Zenith*, I ſcrew the *Quadrant of Altitude:* Then I bring ♈ to the *Meridian*, and count on the *Quadrant of Altitude* upwards 20 Deg. 5 Min· and move it about the *Equinoctial* till thoſe 20 Deg. 5 Min. touch the *Equinoctial*, which I find to be in 38½ Degrees, Therefore I Subtract thoſe 38½ from 90, and the Remains is 51½ Degrees. Therefore I ſay the *Pole* here at *London* is Elevated 51½ Degrees.

The *Declination* and the Elevation is always of the ſame Denomination *North* or *South*, for when they Alter their Denominations, the *Sun* at *Eaſt* can have no *Altitude*, neither can it indeed reach the *Eaſt* point: And therefore in this *Example*, becauſe the *Suns Declination* is *North*, it is the *North Pole* that is Elevated.

To perform the ſame otherwiſe, with a pair of Compaſſes.

Take off with your *Compaſſes* from the *Equator* or *Quadrant of Altitude*, the number of Degrees of *Altitude* Obſerved, and place one Foot at the beginning of ♈ on the inner edge of the *Horizon*, and extend the other directly Upwards towards the *Zenith:* Then move the *Brazen Meridian* through the Notches of the *Horizon*, till the other point of your *Compaſſes* (reſpecting the *Zenith*) reach the Parallel of the *Suns Declnation:* So ſhall the number of Degrees on the *Meridian*, be the number of Degrees that the *Pole* is Elevated above the *Horizon*; and is either *North* or *South*, according as the *Suns Declination* is: As before.

This may yet otherwiſe be performed with the *Quadrant of Altitude*, by taking the *Nut* off the *Meridian*, and laying the edge of its *Index* (ſpecified in Cap. 1. Sect. *6.* of the firſt Book) exactly on the *Eaſt* Line of the *Horizon:* For when that lies ſtraight between the point of *Eaſt*, on the outer verge of the *Horizon*, and the beginning of ♈ in the inner verge of the *Horizon*, then ſhall the upper end of the *Quadrant of Altitude* point directly to the *Zenith:* And if then you turn the *Meridian* through the Notches of the *Horizon*, till the *Suns Altitude* on the *Quadrant of Altitude* Cuts the Parallel of *Declination*, you will have the end of the *Quadrant of Altitude* on the *Meridian* point to the Height of the *Pole:* As before.

PROB. V.

By the Suns Declination *and* Azimuth *at 6 of the Clock given, to find the Height of the* Pole, *and* Almicantar *at ſix.*

ELevate the *Pole* ſo many Degrees as the *Suns Azimuth* is at *6.* and ſcrew the *Quadrant of Altitude* in the *Zenith*, and bring the firſt point of *Aries* to the *Meridian:* Then number on the *Quadrant of Altitude* Upwards the Complement of the *Suns Declination*, and bring that Degree to the *Equator:* So ſhall the degree of the *Horizon* cut by the *Quadrant of Altitude*, be the Complement of the *Poles Elevation*; and the degree of the *Equator* cut by the *Quadrant of Altitude*, ſhall be the *Almicantar* of the *Sun* at *6* of the Clock.

Example.

The *Suns Azimuth* at *6* is $12\frac{3}{4}$ degrees: Therefore I Elevate the *Pole* $12\frac{3}{4}$, and ſcrew the *Quadrant of Altitude* to $12\frac{3}{4}$ degrees, which is in the *Zenith*: Then I bring the firſt point of ♈ to the *Meridian*; the *Suns Declination* is 20 deg. 5 Min. Therefore I number on the *Quadrant of Altitude* *69* deg. 55 Min. which is the Complement of 20 deg. 5 Min. to *90*. this *69* deg. 55 Min. on the *Quadrant of Altitude* I bring to Cut the *Equator*, and find when *69* Deg. 55 Min. cuts the *Equator*, that the *Quadrant of Altitude* Cuts the *Horizon* in $38\frac{1}{2}$ deg. which is the Complement of the *Poles Elevation*: And at the ſame time, the *Quadrant of Altitude* alſo Cuts the *Equator* in $15\frac{1}{2}$ degrees; which is the *Almicantar* or *Altitude* of the *Sun* at *6* a Clock.

PROB. VI.

The Day *of the* Month *and* Hour *of the* Night *given, to find the* Height *of the* Pole, *by a known* Star *Obſerved* Riſing *or* Setting.

REctifie the *Hour Index*, by Prob. 2. of the former Book; and turn the *Globe Weſtwards* till the *Hour Index* points at the Hour of the Night; faſten the *Globe* there, and turn the *Meridian* through the Notches of the *Horizon*, till the known *Star* come to the *Eaſt-ſide* the *Horizon*, if the *Star* be Riſing, or the Weſt, if it be Setting; ſo ſhall the degrees of the *Poles Elevation* be Cut by the *Horizon* under the Elevated *Pole*; and is North or *South* according as the Elevated *Pole* of the *Globe* is.

PROB. VII.

Two Places *given in the ſame* Latitude, *to find the* Difference *of* Longitude.

BRing the firſt Place to the *Meridian*, and note the number of degrees of the *Equinoctial* that comes to the *Meridian* with it; then bring the other Place to the *Meridian*, and note the number of degrees of the *Equator* that comes to the *Meridian* with it: And by Subtracting the Leſſer number from the greater you have the difference of *Longitude*. This needs no *Example*.

PROB. VIII.

Two places given in the ſame Longitude, *to find the Difference of* Latitude.

BRing the places to the *Meridian*, and the degrees of the *Meridian* over the two Places, is the *Latitudes* of them both: And by ſubtracting the Leſſer number of degrees from the Greater, you will have the difference of *Latitude*.

PROB. IX.

Courſe *and* Diſtance *between two* Places *given, to find their Difference in* Longitude *and* Latitude.

SEEK the *Rhumb* you have Sailed upon,as in Prob 34. of the laſt Book, and upon that *Rhumb* make a Mark for the Place you departed from; then with your *Compaſſes* take off from the *Equinoctial* the number of *Leagues* you have Sailed upon that *Rhumb*, by allowing a degree for every 20 *Leagues*, and place one Foot of your *Compaſſes* upon that Mark, and where the other Foot falls on that *Rhumb*,make a Second Mark; then by bringing the Firſt Mark to the *Meridian*, you will ſee on the *Meridian* the *Latitude* of that Mark, and in the *Equator* the *Longitude*, as in Prob. 2. of the laſt Book: And by bringing the Second Mark alſo to the *Meridian*, you will, as before, find the *Longitude* and *Latitude* of the Second Mark alſo. Then by Subtracting the Leſſer *Latitude* from the Greater *Latitude*, and the Leſſer *Longitude* from the Greater *Longitude*, you will have the difference remaining, both of *Longitude* and *Latitude* you are arrived into.

PROB. X.

To find how many Miles *are contained in a* Degree *of any* Parallel.

EVery degree of the *Equinoctial* contains 20 *Engliſh Leagues*, and every League 3 *Engliſh Miles:* But in every *Parallel* to the *Equinoctial*, the degrees diminiſh more and more, even to the *Pole*, where they end in a point. Therefore a degree in any *Parallel* cannot contain ſo many *Miles* as a Degree in the *Equinoctial.* Now that you may know how many *Miles* are contained in a degree of any *Parallel* to the *Equinoctial*, do thus, Meaſure with your *Compaſſes* the Width of any number of degrees in any given *Parallel*; ſuppoſe (for *Example* ſake) 10 degrees in the *Parallel* of 51½; Examine in the *Equator* how many degrees of the *Equator* they will make, and you will find 6⅕ Therefore 1 deg. in the *Equator* making 60 *Miles*, 6 degrees makes 360, to which Add for the ⅕ part 12 *Miles*, makes 372 *Miles*, to be the Meaſure of 10 degrees in the *Parallel* of 51½. So that by dividing 372 by 10, you have 37 *Miles* for the Length of a degree, from *Eaſt* to *Weſt* in the *Parallel* of 51½ degrees.

PROB. XI.

The Rhumb *you have* Sailed *upon, and the* Latitudes *you* departed *from, and are* arrived *to, given, to find the* Difference *of* Longitude, *and the number of* Leagues *you have* Sailed.

FIrſt ſeek the *Rhumb* you have Sailed on, and paſs it through the *Meridian* till it Cuts in the *Meridian* the *Latitude* you departed from : and keeping the *Globe* there ſteddy, make a Mark cloſe by the *Meridian*, under that *Latitude*, and in that *Rhumb* on the *Globe*, and note in the *Equinoctial* the degree of *Longitude* at the *Meridian :* Then paſs that *Rhumb* through the *Meridian* again, till it Cuts in the *Meridian* the *Latitude* you are Arrived to; and in that *Rhumb* and *Latitude* make on the *Globe* another Mark, and examine in the *Equinoctial* the *Longitude* of the Second Mark; for the difference between Firſt and Second Mark, is the difference of *Longitude*; Then open your *Compaſſes* to one degree of the *Equinoctial*, and by meaſuring along in the *Rhumb*, Count how many times that diſtance is contained between the two Points in that *Rhumb*, for ſo many times 20 *Leagues* is the diſtance you have Sailed.

Example.

I Sail upon the *North-Weſt Rhumb*, from the *Latitude* of 10 degrees, into the *Latitude* of 30 degrees 40 Minutes. Therefore I find the *North-Weſt Rhumb*, and turn the *Globe* through the M*eridian* till this *Rhumb* Cut the M*eridian* in the firſt *Latitude*, *viz.* in 10 degrees, and directly under 10 degrees upon the *Rhumb* I make a Prick, and alſo find 10 degrees 3 *Minutes* of the *Equator* at the M*eridian*, for the *Longitude* of the Firſt Place. Then I turn the *Globe* again through the M*eridian*, till the ſame *Rhumb* Cut the M*eridian* in the Second *Latitude*, *viz.* in 30 degrees 40 Minutes, and directly under thoſe 30 degrees 40 Minutes, in the ſame *Rhumb*, I make another Prick, which repreſents the Place I am Arrived to: I examine the *Longitude* of this Prick, as before, and find it 32 degrees 10 Minutes. Therefore I Subtract the Firſt *Longitude*, *viz.* 10 degrees 3 Minutes, from the Second *Longitude*, *viz.* 32 degrees 10 Minutes, and there Remains 22 degrees 7 Minutes, for the difference of *Longitude*.

Then for Examining the *Diſtance*, I open my *Compaſſes* to 1 degree on the *Equinoctial*, and meaſure upon the *Rhumb* how oft that Diſtance is contained between the two Pricks, and find 29$\frac{1}{4}$ that is 29 degrees 15 minutes, which multiplied by 20, gives 585 for the number of *Leagues* Sailed upon that *Rhumb*.

The Reaſon why I open the *Compaſſes* no wider than to 1 degr. is, becauſe the *Rhumbs* being Circular or Crooked Lines, the diſtance on them may be meaſured more exactly, by often counting that 1 degr. in them, than if the *Compaſſes* had been opened to many degrees. Thus if the *Compaſſes* had been opened wide enough to reach between the two Pricks aforeſaid, I ſhould not have had above 583 *Leagues* for the diſtance between the two places: Neither is there indeed more *great Circle diſtance* between them; But I Sailed upon a *Rhumb*, that is, I follow'd the *Courſe* of a Circular Winding-Line, and ſo fetch a *Compaſs* about to come to theſe two Pricks; and therefore I have in truth Sailed 585 *Leagues*. For the ſegment of a *Rhumb* between two Places, is always greater than a ſtraight Line drawn betwixt them; yea, ſometimes by Half, or more, in Places near either *Pole*.

Note, If you be not very curious in opening your *Compaſſes* to this ſmall diſtance, you may, in oft turning them about upon the *Rhumb*, commit error in your meaſuring: Therefore when you have taken the diſtance of one degree, try if you neither gain or loſe any thing in meaſuring 10, or 20 degrees of the *Equinoctial* by them, for then your *Compaſſes* are opened to a width exact enough for your purpoſe.

PROB. XII.

The Longitude *and* Latitude *of two* Places *given, to find* Courſe, *and* Great Circle *Diſtance between them.*

FInd on the *Globe* the *Longitudes* and *Latitudes* given, and make Pricks to either *Longitude* and *Latitude:* If any *Rhumb* paſs from one Place to the Other, that is (without more ado) the *Rhumb* ſought. But if no *Rhumb* paſs through, take the *Rhumb* that runs moſt Parallel to the two Pricks: For that ſhall be the *Rhumb*, or the neareſt *Rhumb* that theſe two Pricks *Bear* on. An *Example* of this ſee in Prob. 34. of the laſt Book: And the *Great Circle Diſtance* between theſe two Pricks, you may find, as by Prob. 33. of the ſame Book.

PROB. XIII.

The Latitude *you* departed *from, and the* Latitude *you are* arrived *to, and the number of* Leagues *you have* Sailed, *given, to find the* Rhumb *you have* Sailed *on, and Difference of* Longitude.

MAke a Prick on the *Globe* in the *Latitude* you *departed* from, then open your *Compaſſes* to the number of *Leagues* you have Sailed, by taking for every 20 *Leagues*, 1 degrees of the *Equator*, Half a degree for 10 *Leagues*, a

Quarter of a degree for 5 *Leagues*, and ſo proportionably for any other number of *Leagues*. Place one Foot of your *Compaſſes* in the Prick made for the *Latitude* you departed from, and extend the Other towards the *Latitude* you are arrived to, and deſcribe an occult Arch; Turn the *Globe* till this occult Arch come to the *Latitude* on the *Meridian*, and where the *Latitude* Cuts this occult Arch, make another Prick to repreſent the *Latitude* you are *arrived* to; ſo ſhall the *Rhumb*, paſſing through thoſe two Pricks (or that is moſt Parallel to thoſe two Pricks) be as in the laſt Prob. the *Courſe* or the *Rhumb* thoſe two Pricks *Bears* on.

The difference of *Longitude* you may find, as by Prob. 11.

PROB. XIV.

To find by the Globe *the* Variation of the Needle; *commonly called the* Variation of the Compaſs.

OBſerve by a *Compaſs* whoſe Wyer is placed juſt under the *Flower-de-luce*, what Point of the *Compaſs* the *Sun* Riſes or Sets on, Morning, or Evening: Then examine by Prob. 10. of the Second Book, what degree of the *Horizon* the *Sun* Riſes or Sets on, by the *Globe* alſo; and if the Riſing or Setting be the ſame, both on the *Globe* and *Compaſs*, there is no *Variation* in your Place: But if there be difference between the Riſing or Setting by the *Compaſs* and the *Globe*, then is there *Variation* in your Place.

If the Point the Sun Riſes upon in the *Compaſs* be nearer the the *North* Point, than the Point the *Sun* Riſes upon by the *Globe*, the *Variation* is Eaſtwards.

If the Point the *Sun* Sets upon in the *Compaſs* be nearer the North, than the Point it Sets upon by the *Globe*, the *Variation* is Weſtwards.

If the Point the *Sun* Sets upon in the *Compaſs* be further from the *North* Point, than the Point the *Sun* Sets upon by the *Globe*, the *Variation* is Eaſtwards.

If the Point the *Sun* Riſes upon in the *Compaſs* be further from the *North* Point, than the Point the *Sun* Riſes upon by the *Globe*, the *Variation* is Weſtwards. And ſo many degrees as there is between the Point of Riſing or Setting found by the *Compaſs*, and the Point of True Riſing or Setting found by the *Globe*, ſo many degrees in the *Variation* from the *North* towards the *Eaſt* or *Weſt* Point.

Otherwiſe, when the Sun *hath* Altitude.

Having the *Altitude* of the *Sun* ; find by Prob. 22. of the Second Book, its *Azimuth :* Then examine by a *Compaſs* whether the true *Azimuth* found by the *Globe*, agree with the *Azimuth* found by a *Nautical Compaſs* : If they agree, there is no *variation* : But if the *Azimuth* of the *Compaſs* before Noon be nearer the *North*, than the true *Azimuth* found by the *Globe*, the *Variation* is Eaſtwards.

If the *Azimuth* by the *Compaſs* Afternoon be nearer the *North*, the *Variation* is Weſtwards.

If the *Azimuth* by the *Compaſs* Afternoon be further from the *North*, the *Variaton* is Eaſtwards.

If the *Azimuth* by the *Compaſs* before Noon be further from the *North*, the *Variation* is Weſtwards.

And this *Variation* ſhall be as aforeſaid, ſo many degrees as there is between the *Azimuth*, Obſerved by the *Compaſs*, and the true *Azimuth*, Obſerved by the *Globe*.

PROB. XV.

To Keep a Journal *of the Ships* Way *by the* Globe.

BY ſome of theſe foregoing Problemes, you may Daily (when Obſervations can be made) find both the *Longitude* and *Latitude* on the *Globe*, of the Place you are Arrived to, and alſo the *Way* the Ship hath made, and make Pricks on the *Globe* in their proper Places for every days Voyage, ſo truly, and ſo naturally, that if you kept your reckoning aright, you may be ſure you cannot miſs any thing of the Truth it ſelf; and that with leſs Trouble, and greater Advantage, than keeping a Book of every days Reckoning.

PROB. XVI.

To Steer *in the* Night *by the Stars.*

REctifie the *Globe* and *Hour Index* as by Prob. 2. of the laſt Book, and turn about the *Globe* till the Index of the *Hour Circle* points to the Hour of the Day or Night; Then turn the *Globe* till the Difference of *Longitude* between the Place you depart from, and the place you Sail to, paſs through the *Meridian*; and if any *Star* in the *Latitude* of the Place you Sail to, Come to the *Meridian*, or near the *Meridian*, with the Degree of the Difference of *Longitude*, that *Star* is at that Time in or neer the *Zenith* of that Place you Sail to: And by finding the ſame *Star* in *Heaven*, as by Prob. 44. of the laſt Book, you may Direct your Ship towards that *Star*, and Sail as confidently (ſays Mr. *Blagrave*) as if *Mercury* were your Guide. But becauſe this *Star* Moves from the *Zenith* of this Place, you muſt often examine what *Star* is come to the *Zenith*, and ſo often Change the *Star* you *Steer* by, as the length of your Voyage may require.

PROB. XVII.

How to Platt *on the* Globe *New* Land, *never before Diſcovered.*

THeſe two following Problemes, are two Chapters of Mr. *Wright*'s delivered by him as follows.

It may ſonetimes fall out in New Diſcoveries, or when your Ship, by means of a Tempeſt, is Driven out of her right *Courſe*, that you ſhall come to the ſight of ſome *Iſle*, *Shoal*, or *New Land*, whereof the *Mariner* is utterly ignorant: And to make ſome Relation of the ſame, or go unto it ſome other Time, If you deſire to Set it down on your *Globe* in the true Place, you may do it after this manner; So ſoon as you have Sight thereof, mark it well, Firſt with your *Compaſs*, Obſerving diligently upon which *Point* thereof it lieth. And Secondly, you muſt there take the Height of the *Sun*, or of the *Pole-ſtar*, as you were taught Prob. 13. of the Second Book, that you may know in what Point your Ship is, and that Point you muſt call the *Firſt Point*; which being ſo done, your Ship may Sail on her *Courſe* all that Day, till the Day following, without loſing her Way: And the next Day mark the Land again, and ſee upon what *Point* it lieth; and then take your *height*, and with it *Caſt your Point of Traverſe* once again; and that you may call your *ſecond Point*. Then take a pair of *Compaſſes*, and placing one Foot upon the firſt *Point*, and the Other upon the *Rhumb*, towards which the Land did *Bear* when you *Caſt your firſt Point*; Set alſo one Foot of another pair of *Compaſſes*, in the *ſecond Point*, and the other Foot upon the *Rhumb* upon which the Land lay when you *Caſt your Second Point*, and theſe two *Compaſſes* thus Opened, you muſt move by their *Rhumbs*, till thoſe two Feet of both *Compaſſes* do meet together, which were moved from the foreſaid *Two Points*: And where they do ſo meet together, there you may ſay is the Land which you Diſcovered; which Land you may Point out with the *In-lets*, and *Out-lets*, or *Capes*, and other *Signs*, which you ſaw thereupon. And by the Graduation you may ſee the *Latitude* thereof, that thereby you may find it, if at any time after you go to Seek for it.

PROB. XVIII.

Seeing two known Points *or* Capes *of* Land, *as you Sail along, how to know the* diſtance *of your Ship from them.*

PItch one Foot of one pair of *Compaſſes* upon one of the two foreſaid *Capes*, and the other Foot upon the *Rhumb*, which in the *Nautical Compaſs* pointeth towards that *Cape*: And in like manner ſhall you do with another pair of *Compaſſes*, placing one Foot thereof upon the other known *Cape*, and the other Foot upon the *Rhumb*, which ſtretched towards the ſaid Second *Cape*; and moving the two *Compaſſes* (ſo opened) by theſe two *Rhumbs* off from the Land, the very ſame Point where the two Feet which came from the two *Capes* do meet, you may affirm to be the very Point where your Ship is; And then meaſuring by the Degrees of the *Equinoctial*, you may ſee what Diſtance there is from the ſaid Point to either of the foreſaid *Capes*, or to any other Place, which you think good; for it is a very eaſie matter, if you know the Point where your Ship is.

PROB. XIX.

Of Tides, *and how by help of the* Globe, *you may in general Judge of them.*

Divide the *Equinoctial* into 30 equal parts, as was directed in Prob. 54. of the laſt Book. Theſe 30 equal parts repreſent the 30 Days of the *Moons* Age.

Then on the *North* and *South* Points of the *Compaſs*, in the outmoſt Verge of the *Horizon*, write with red Ink 12. From the *North Eaſtwards*, *viz.* at the Point *North and by Eaſt*, write 11¼ At the next Point to the ſame way, *viz. North North Eaſt*, write 10½ At the next, *viz. North and by North*, Write 9$_4$ And ſo ſorward to every Point of the *Compaſs*; rebating of the laſt Hour ¾ till you come to 12, in the *South*; where you muſt begin again to mark that Semi-Circle alſo in the ſame Order you did the laſt. In this Circle is then repreſented the *Points of the Compaſs* the *Sun* and *Moon* paſſeth by every Day; and the Figures annexed repreſent twice 12 Hours of Day and Night.

Having thus prepared your *Globe* and *Horizon*, you may, by having the *Moons* Age, and the *Point of the Compaſs* on which the *Moon* maketh *Full Sea* at any place given, find at what Hour of Day or Night it ſhall be *High Tide* in the ſame place. Thus,

It is a known Rule that a *North* and *South Moon* makes High Water at *Margarete*. Therefore Bring the firſt point of ♈ to the *North* or *South* Point in the *Horizon*, and Elevate the *North Pole* into the *Zenith:* Then Count in the *Equinoctial*, the Days of the *Moons* Age numbered in red figures; and the Hour and Minutes written in red figures, annexed to the Names of the Winds that ſtand againſt the *Moons* Age, ſhall be the Hour of High Tide on that Day or Night at *Margarete*.

The End of the Third Book.

The Fourth BOOK.

Shewing the Practical Uſe of the

GLOBES.

Applying them to the Solution of

ASTROLOGICAL PROBLEMES.

LIBRARY

PRÆFACE.

THE *Practice of* Aſtrology *is grounded upon a twofold* Doctrine. *The firſt for Erecting a* Figure of Heaven, *Placing the Planets in it, Finding what Aſpects they Bear each other, and in what* Place *of* Heaven *they are conſtituted*, &c. *And this we call the* Aſtronomical *part of* Aſtrology.

The Second *is*, *How to Judge of the* Events of Things *by the* Figure Erected: *And this is indeed the only* Aſtrological *part.*

The Firſt of theſe I ſhall briefly Handle ; becauſe what therein is propoſed may be performed by the Globe, *both with Speed, Eaſe, Delight and Demonſtration. The Second I ſhall not meddle with, but refer you to the whole Volumes already Written upon that Subject.*

PROB.

PROB. I.

To Erect a Figure *of the* 12 Houſes *of* Heaven.

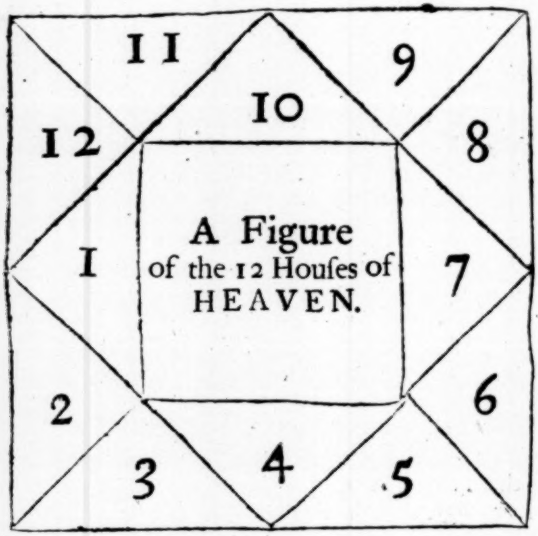
BEfore you *Erect* a Figure of the 12 *Houſes* of *Heaven*, it will be requiſite you place the *Planets*, ☊ and ☋ according to their *Longitude* and *Latitude* upon the *Globe*, as was directed Prob. 55. of the Second Book: For then, as you Divide the *Houſes* of your *Figure* by the *Circle of Poſition*, you may, by inſpection, behold in what *Houſes* the Planets are Situated, and alſo ſee what Fixed *Stars* they are Applying to, or Separating from. But to the matter.

There is a diſagreement between the Ancient and Modern *Aſtrologers*, about *erecting* a *Figure* of *Heaven*. Mr. *Palmer* in his Book, *Spherical Problemes*, Chap. 48. mentions four ſeveral Ways, and the Authors that uſed them: Whereof one of them is called the *Rational Way* uſed by *Regiomontanus*; and now generally practiſed by all the *Aſtrologers* of this Age. This way the Face of *Heaven* is divided into Twelve parts, which are called the *Twelve Houſes of Heaven*, numbered from the *Aſcendent* or Angle at *Eaſt* downwards with 1, 2, 3, *&c.* As in the following Figure.

In a *Direct Sphere*, *viz.* under the *Equator*, theſe *Twelve Houſes* are twelve equal parts: But in an *Oblique Sphere* they are unequal parts, and that more or leſs according to the quantity of the *Spheres* Obliquity.

Theſe *Twelve Houſes*, are divided by 12 Semi-*Circles of Poſition*; which are Semi Circles paſſing from the two interſections of the *Horizon* and *Meridian*, through any *Star*, Degree or Point in the *Heavens*.

Four of theſe *Houſes* are named *Cardinals*. The *Firſt* and moſt Eminent of theſe *Cardinals*, is the *Firſt Houſe*, or Angle of *Eaſt*, called the *Aſcendent*; where the Semi Circle of *Poſition* is the ſame with the *Eaſtern* Semi Circle of the *Horizon*. The *Second Cardinal*, is the *Tenth Houſe*, or the Angle of *South*, called *Medium Cœli*, or *Culmen Cœli*, where the Semi Circle of *Poſition* is the ſame with the Semi Circle of the *Meridian* above the *Horizon*. The *Third Cardinal* is the *Seventh Houſe*, or the Angle of *Weſt*, called the *Deſcendent*; where the Semi-Circle of *Poſition* is the ſame with the *Weſtern* Semi Circle of the *Horizon*.



A Figure of the 12 Houſes of HEAVEN.

zon. The F*ourth Cardinal* is the F*ourth Houſe*, or Angle of *North*, called *Imum Cœli*, where the Semi-*Circle of Poſition*, is the ſame with the Semi-Circle of the M*eridian* under the *Horizon*.

The Degrees and Minutes of the *Ecliptick* upon the *Cuſps* of theſe *Four Houſes* (that is, upon the beginning of theſe *Houſes*) are found all at once; only by bringing the Riſing Deg. of the *Ecliptick* to the *Horizon*: (for the *Horizon* repreſents the *Cuſp* of the *Aſcendent*) and then ſhall the M*eridian* Cut the Deg. of the *Ecliptick* on the *Cuſp* of the *Tenth Houſe*. The *Weſtern* Semi-circle of the *Horizon* ſhall cut the Deg. of the *Ecliptick* on the *Cuſp* of the *Seventh Houſe*: And the Semi-Circle of the M*eridian* under the *Horizon*, ſhall Cut the Degree of the *Ecliptick* on the *Cuſp* of the *Fourth Houſe*.

If you have the Day of the Month, you may, by Prob. 3. of the Second Book, find the *Suns* Place; and if you have the Hour of the Day, you may, by firſt Rectifying the *Globe*, as by Prob. 2. of the ſame Book, turn about the *Globe* till the *Index* of the *Hour-Circle* point to the ſame Hour in the *Hour-Circle*, and you will then at the *Eaſtern* Semi-Circle of the *Horizon*, have the Degree of the *Ecliptick* that is Riſing, and by Conſequence (as aforeſaid) all the *Cardinal Points* in their reſpective Places.

Now to find what Degree of the *Ecliptick* occupies the *Cuſps* of the other *Eight Houſes* of *Heaven*; Do thus, the *Globe* Rectified, as aforeſaid, Move the Semi-*Circle of Poſition* upwards, till 30 Degrees of the *Equator* ſhall be contained between it and the *Eaſtern* Semi-Circle of the *Horizon*; ſo ſhall the Semi-*Circle of Poſition* Cut in the *Ecliptick* the Degree and Minute of the *Ecliptick* on the *Cuſp* of the *Twelfth Houſe*; and its Oppoſite Degree and Minute in the *Ecliptick* ſhall be the *Cuſp* of the *Sixth Houſe*; for you muſt note, that if you have but the Deg. and Minute of the *Ecliptick* upon the *Cuſps* of Six of the *Houſes*, the Oppoſite Degrees and Minutes of the *Ecliptick* ſhall immediately poſſeſs the *Cuſp* of every Oppoſite *Houſe*.

Then move the *Circle of Poſition* over 30 Degrees more of the *Equinoctial*, ſo ſhall the Degree of the *Ecliptick*, Cut by the *Circle of Poſition*, be the Degree of the *Ecliptick* upon the *Cuſp* of the *Eleventh Houſe*; and its Oppoſite Degree in the *Ecliptick*, ſhall be upon the *Cuſp* of the *Fifth Houſe*. The Degree of the *Ecliptick* upon the *Cuſp* of the *Tenth* and *Fourth Houſes* was found as before. Then remove the *Circle of Poſition* to the *Weſtern* ſide of the *Meridian*, and let it fall towards the *Horizon*, till 30 Degrees of the *Equator* are contained between the *Meridian* and it, ſo ſhall the Deg. of the *Ecliptick*, Cut by the Semi-*Circle of Poſition*, be the Degree of the *Ecliptick* on the *Cuſp* of the *Ninth Houſe*; and the Oppoſite Degree of the *Ecliptick* ſhall be upon the *Cuſp* of the *Third Houſe*. Let the Semi-*Circle of Poſition* fall yet lower, till it paſs over 30 degrees more of the *Equator*, ſo ſhall the degree of the *Ecliptick*, Cut by the Semi-*Circle of Poſition*, be the degree of the *Ecliptick* on the *Cuſp* of the *Eighth Houſe*; and the Oppoſite degree of the *Ecliptick* ſhall be upon the *Cuſp* of the *Second Houſe*. The degrees of the *Ecliptick* on the *Cuſp* of the *Seventh Houſe*, and *Aſcendent*, were found as before.

Example.

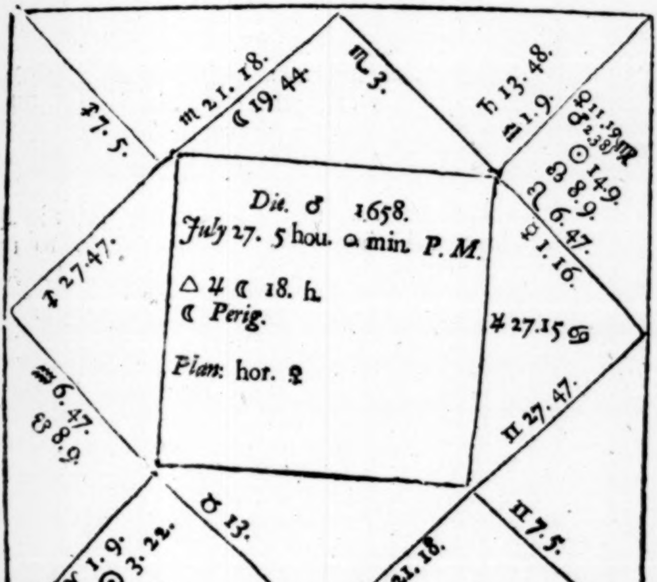
Example.

I would Erect a *Figure of Heaven* for *July* 27. 5 Hours, 0 Minutes Afternoon, 1658, in the *Latitude* of *London*, *viz.* 51½ Degrees, *North Latitude*.

I firſt place the *Planets*, ☊, and ☋ on the *Globe*, as by Prob. 55. of the ſecond Book was directed: Yet not exactly as I find them in the *Ephemeris*, for that ſhews only their place in the *Ecliptick* at Noon: Therefore I conſider how many Degrees or Minutes each *Planets* Motion is in a whole Day, or 24 Hours, by Subtracting the *Ecliptical* Degrees and Minutes of the *Planets* place that Day at Noon, from the *Ecliptical* Degrees and Minutes of the *Planets* place the next day at Noon: Or contrarily, if the *Planets* be *Retrograde*: For the Remains of thoſe Degrees and Minutes is the Motion of the *Planet* that Day; Therefore proportionably to that Motion I place the *Planet* forward in the *Eclipick*: (or backwards if it be *Retrograde*:) As if the *Sun* ſhould move forwards 1 Degree, that is 60 Minutes in a whole Day, or 24 Hours, then in 12 Hours he ſhould move 30 Minutes, in 6 Hours 15 Minutes, in 4 Hours 10 Minutes, in 1 Hour 2½ Minutes, and ſo Proportionably for any other Space of Time: Which I conſider before I place the *Planets* on the *Globe*.

Having thus placed the *Planets* on the *Globe*, I Elevate the *North Pole* 51½ Degrees above the *Horizon*, and find the *Suns* place by Prob. 3. Book 2. to be in ♌ 14 Degrees 9 Minutes, Therefore I bring ♌ 14 Degrees 9 Minutes to the *Meridian*, and the *Index* of the *Hour-Circle* to 12. Then I turn the *Globe Weſtward*, becauſe it is Afternoon, till the *Index* point to 5 Hours Afternoon, and with a Quill I faſten the *Globe* in this Poſition: Then I examine what Deg. of the *Ecliptick* is at the *Aſcendent* or *Horizon*, and find ♐ 27 47 to which *Sign*, Degree and Minute ♊ 27 47 is Oppoſite; and therefore as aforeſaid, upon the *Cuſp* of the *Seventh Houſe*: Lifting up the *Circle of Poſition* till it paſs over 30 Degrees of the *Equator* from the *Horizon* upwards, I find ♐ 7 5 Cut by it in the *Ecliptick*, which is the *Sign*, Deg. and Minute upon the Cuſp of the *Twelfth Houſe*, and its Oppoſite *Sign*, Degree and Minute is ♊ 7 5, which is upon the *Cuſp* of the *Sixth Houſe*: Then lifting up the *Circle of Poſition* again, till it paſs over 30 Degrees more of the *Equinoctial*, I find

Cut by the *Circle of Poſition* ♏ 21 18 which is the *Sign*, Degree, and Minute upon the *Cuſp* of the *Eleventh Houſe*; and its Oppoſite *Sign*, Deg. and Minute is ♉ 21 18 which is upon the *Cuſp* of the *Fifth Houſe*. ♏ 3 20 is at the *Meridian*, which is the *Cuſp* of the *Tenth Houſe*, and the *Sign*, Deg. and Minute Oppoſite to it, is ♉ 3 20 which is on the *Cuſp* of the *Fourth Houſe*. Then taking the *Semi-Circle of Poſition* off its Poles, I place it in the *Weſt* ſide the *Meridian*, and let it fall towards the *Horizon* till it paſs over 30 degrees of the *Equator* from the *Meridian*, and find the *Circle of Poſition* cut the *Ecliptick* in ♎ 19 which is the *Sign*, Deg. and Minute on the *Cuſp* of the *Ninth Houſe*, Oppoſite to ♎ 19 is ♈, therefore ♈ 19 is upon the *Cuſp* of the *Third Houſe*: Letting the *Circle of Poſition* fall yet lower till it paſſes over 30 Degrees more of the *Equator*, I find it Cut the *Ecliptick* in ♌ 6 47 which is the *Sign*, Degree and Minute up-


♐ 7. 5.
♏ 21. 18.
☾ 19. 44
♏ 3.
♄ 13. 48.
♎ 1. 9.
♀ 11. 19 ♍
♂ 2. 38
☉ 14. 9.
☋ 8. 9.
♌ 6. 47.
☿ 1. 16.
♐ 27. 47.
Die. ♂ 1658.
July 27. 5 hou. 0 min. P. M.
△ ♃ ☾ 18. h.
☾ Perig.
Plan: hor. ♀
♃ 27. 15 ♋
♒ 6. 47.
☊ 8. 9.
♊ 27. 47.
♈ 1. 9.
☉ 3. 22.
♉ 13.
♉ 21. 18.
♊ 7. 5.

on the *Cuſp* of the *Eight Houſe*; and its Oppoſite *Sign*, Degree and Minute is ♒ 6,47. which is upon the *Cuſp* of the *Second Houſe*; So have you a *Figure* of the Face of Heaven; which if you have future uſe for, you may ſet down the ſeveral Characters in the proper places of a *Figure*, as they are on the other ſide the Leaf.

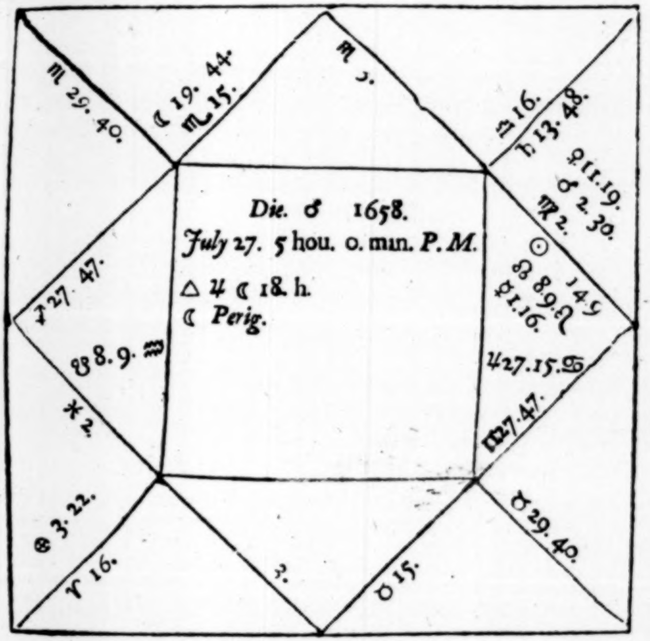
PROB. II.

To Erect a Figure *of* Heaven *according to* Campanus.

R*Egiomontanus* (as aforeſaid) makes the beginning of every *Houſe* to be the *Semi-Circle* drawn by the ſide of the *Semi-Circle of Poſition* according to the Succeſſion of every 30th Deg. of the *Equator* from the Horizon. But *Campanus* makes it to be the *Semi-Circle* drawn by the ſide of the *Semi-Circle of Poſition*, according to the Succeſſion of every 30th Degree of the *Prime Verticle*, or *Eaſt Azimuth*, which is repreſented by the *Quadrant of Altitude* placed at the *Eaſt* Point.

The four *Cardinals* are the ſame, both according to *Regiomontanus* and *Campanus*, but the other *Eight Houſes* differ. Therefore when you would find them according to *Campanus*; Rectifie the *Globe* and *Quadrant of Altitude*, and bring the lower end of the *Quadrant of Altitude* to the *Eaſt* Point in the *Horizon*: Then count from the *Horizon* upwards 30 Degrees on the *Quadrant of Altitude*; and bringing the *Circle of Poſition* to thoſe 30 Degrees, examine where the *Circle of Poſition* Cuts the *Ecliptick*; which at the aforeſaid Time is in ♏ 29 40 for that Deg. and Min. is upon the *Cuſp* of the *Twelfth Houſe*, and its Oppoſite Deg. and Min. in the *Ecliptick*, *viz.* ♉ 29 40 is upon the *Cuſp* of the *Sixth Houſe*: Lift up the *Circle of Poſition* 30 Degrees higher upon the *Quadrant of Altitude* (*viz.* to 60 Degrees) and the *Circle of Poſition* will Cut the *Ecliptick* in ♏ 15 Degrees for the *Cuſp* of *Eleventh Houſe*, and its Oppoſite Deg. and Minute in the *Ecliptick*, *viz.* ♉ 15 is upon the *Cuſp* of the *Fifth Houſe*. The Degree and Minute of the *Ecliptick* on the *Cuſp* of the *Tenth* and *Fourth Houſes*, is at the *Meridian*.

Then transferring the *Circle of Poſition* to the *Weſt* ſide of the *Meridian*, and the *Quadrant of Altitude* to the *Weſt* Point in the *Horizon*, let the *Semi-Circle of Poſition* fall 30 Degrees from the *Meridian* of the *Quadrant of Altitude*, and it will Cut in the *cliptick* ♎ 16 degrees, for the *Cuſp* of the Ninth Houſe, and its oppoſite degree and minute in the Ecliptick, *viz.* ♈ 16. is upon on the *Cuſp* of the Third Houſe: Let fall the *Circle of Poſition* 30 degrees lower on the *Quadrant of Altitude*, and it will Cut the Ecliptick in ♍ degrees for the *Cuſp* of the Eighth Houſe, and its oppoſite degree, *viz.* ♓ 2 degrees, is on the *Cuſp* of the Second Houſe: The *Cuſps* of the Seventh and Aſcendant, is the ſame with *Regiomontanus*, *viz.* 27, 47, and ♐ 27, 47. The Figure follows.


♏ 29. 40.
☾ 19. 44.
♏ 15.
♍ 3.
♎ 16.
♄ 13. 48.
♀ 11. 19.
♂ 2. 30.
♍ 2.
☉ 14. 9
☊ 8. 9. ♌
☿ 1. 16. ♌
♃ 27. 15. ♋
♊ 27. 47.
♉ 29. 40.
♉ 15.
3.
♈ 16.
⊗ 3. 22.
♓ 2.
☋ 8. 9. ♒
♐ 27. 47.
Die. ♂ 1658.
July 27. 5 hou. 0. min. P. M.
△ ♃ ☾ 18. h.
☾ Perig.

PROB. III.

To find the Length of a Planetary Hour.

A*Strologers* divide the Artificial Day (be it long or ſhort.) into 12 Equal Parts, and the Night into 12 Equal Parts: Theſe Parts they call Planetary Hours. The

Firſt of theſe Planetary Hours, takes its denomination from the Planetary Day; and the reſt are named orderly from that Planet, according to the Succeſſion of the Planetary Orbs. As if it be *Monday*, that is the *Moon's* Day, (as by Prob. 42. of the Second Book,) the Planet Reigning the Firſt Hour ſhall be ☽, the Planet Ruling the Second Hour ſhall be ♄, the Third Planetary Hour ſhall be ♃, the Fourth ♂ the Fifth ☉, the Sixth ♀, the Seventh ☿: Then begin again with ☽ for the Eighth Planetary Hour, ♄ for the Ninth, and ſo through the whole Day and Night, till the *Sun* Riſe again the next Day.

The Length of this Planetary Hour is found by the *Globe* thus, The *Globe* Rectified, bring the Suns Place to the Eaſt-ſide the Horizon, and make a Prick at the degree of the Equator that comes to the Horizon, with it. Then remove the *Suns* place to the Meridian, and count the number of degrees of the Equator, comprehended between that Prick and the deg. now at the Horizon; and divide that number of degrees and minutes by *6*, becauſe there is *6* Planetary Hours paſt ſince Noon; and the Quotient ſhall ſhew the number of degrees and minutes, that paſs through the Meridian in one Planetary Hour.

Example.

July 27. I would know the Length of a Planetary Hour here at *London*: I Rectifie the *Globe*, and bring the *Suns* place, *viz.* ♌ 13.15 to the Eaſtern-ſide the Horizon, and find 115 degrees of the Equator come to the Horizon with it, to this 115 degrees, I make a Prick: Then I turn the *Suns* place to the Meridian, and find 226 degrees of the Equator at the Horizon. Therefore I either count the number of degrees between the Pricks at the deg. of the Equator at the Horizon, or elſe ſubtract the Leſſor from the greater, but both ways I find 111 degrees of the Equator to paſs through the Meridian (or the Horizon,) in ſix Planetary Hours: Therefore dividing 111 by *6*, I find 18 deg. 30. min. of the Equator, to paſs through the Meridian in one Planetary Hour; which 18 degrees 30 minutes reduced into Time, yields 74 Minutes, by accounting for every 15 degrees one hour, for 1 deg. 4 minutes, and for half a deg. 2 minutes of Time, and ſo proportionably; ſo that the Length of a Planetary Hour, *July* 27, is 1 common Hour and 14 Minutes here at *London*.

PROB.

PROB. IV.

The Length of a Planetary Hour *known, to find what* Planet Reigneth, *any given* Hour *of the Day or Night.*

THE *Globe* Rectified, as in the laſt Probleme; Turn about the *Globe* till the *Index* of the Hour-Circle points to the Hour of the Day in the Hour-Circle. Then count the number of degrees comprehended between the deg. of the Equator at the Horizon, and the Prick in the Equator, made as in the laſt Probleme, and reduce that number of degrees into Minutes of Time, by reckoning 4 Minutes of Time for every deg. of the Equator. Reduce alſo the number of degrees and Minutes that paſs through the Meridian in one Planetary-Hour into Minutes, by allowing (as aforeſaid,) 4 Minutes for every deg. and then divide the Firſt number by the Second, and the Quotient ſhall be the number of Planetary Hours ſince Sun-Riſing. Having the number of Planetary Hours ſince Sun-Riſing; reckon the Firſt Planetary Hour, by the name of that Planet that bears the denomination of the Day, the Second Planetary Hour by the Planet ſucceeding that in order, the Third by the next in order, and ſo for all the reſt, till you come to the laſt Planet, *viz.* ☾; and then begin again with ♄, and ſo to ♃, *&c.* till you have reckoned ſo many Planets as there are Planetary Hours ſince Morning; and that Planet the number ends on, ſhall be the Planet Reigning that Planetary Hour.

Example.

July 27. as aforeſaid, I would know what Planet Rules at 5 a Clock paſt Noon: The Length of the Planetary Hour this Day (found by the laſt Probleme,) is 1 Hour 14 Minutes: Therefore the *Globe* Rectified, I bring the *Index* of the Hour-Circle, to the Hour of the Day, *viz.* 5 a Clock in the Hour-Circle, and then count the number of degrees between the Prick made, as by the laſt Probleme, and the deg. of the Equator at the Horizon; and find them 187, which I reduce into Minutes, by allowing for every deg. 4 minutes, and that gives 748 Minutes. This 748 Minutes, I divide by the Minutes contained in one Planetary Hour this Day, *viz.* by 72, and find 10 Hours 8 Minutes; which ſhews, there are 10 *Planetary Hours* and 8 Minutes paſt and gone ſince *Sun* Riſing. Therefore ♂ being the *Planet*, after whoſe Name the Day is called, *viz. Dies Partis*, ♂ is, as aforeſaid, the Ruler of the Firſt *Planetary Hour:* From him I count the *Planet* ſucceeding, which is ☉ for the *Second hour*; from ☉ I count the Planet ſucceeding, which is ♀ for the *Third hour*, and ſo on to ☿ and ☽; and then I begin the Round again with ♄, ♃ ♂, and ☉, till I come again to ♀, which is the *Tenth Planetary Hour* ſince *Sun* Riſing; and the Minutes remaining being 8, ſhews, that there is 8 Minutes paſt ſince ſhe began to *Reign.*

PROB. V.

To find Part of Fortune *by the* Globe.

COunt the number of Degrees and Minutes contained between the *Suns* place and the *Moons* place, beginning at the *Suns* place, and counting according to the ſucceſſion of *Signs*, till you come to the *Moons* place; and having found that number of degrees and minutes, add them to the number of degrees and minutes *Aſcending*, reckoned from the firſt point of ♈. If the Sum exceed 360, caſt away 360, and the Remainder ſhall be the number of degrees and minutes from the firſt point in ♈, in which *Part of Fortune* falls. But if it do not exceed 360, you have already the number of degrees and minutes from the firſt point of ♈, in which you muſt place *Part of Fortune.*

Example.

I would find the place of *Part of Fortune*, for the Time of our *Figure:* I ſeek the two Pricks repreſenting ☉ and ☽, and find ☉ in ♌ 14 9 and in ♏ 19 44: Therefore, counting from the *Suns* place to the *Moons* place, according to the ſucceſſion of *Signs*, I find 95 degrees 35 minutes contained between them: This 95 degrees 35 minutes, I add to 267 degrees 47 minutes, the degree and minute contained between the firſt point of ♈, and the *Aſcendent*, and they make together 363 degrees 22 minutes. This exceeds 360, therefore I caſt away 360, and the Remains are 3 degrees 22 minutes, for the place in the *Ecliptick* of *Part of Fortune*, reckoned from the firſt point of ♈.

Therefore, this Character ⊖, which repreſents *Part of Fortune*, I ſet in its proper place of the *Figure*, as I did the *Planets*.

PROB. VI.

To find in what Circle *of* Poſition *any* Star, *or any Degree of the* Ecliptick *is.*

CIrcles of *Poſition*, are numbered from the Horizon upward, upon the *Quadrant of Altitude*, placed at the *Eaſt* or *Weſt* point of the Horizon. Therefore, when you would find what *Circle of Poſition* any *Star*, or Degree of the *Ecliptick* is in, Rectifie the *Globe* and *Quadrant of Altitude*, and bring the lower end of the *Quadrant of Altitude* to the *Eaſt* or *Weſt* point of the Horizon, and lift up the *Circle of Poſition*, till it come to the *Star*, or Degree of the *Ecliptick* propoſed, and the number of Degrees the *Circle of Poſition* then cuts in the *Quadrant of Altitude*, is the number of the Circle of Poſition, that the *Star*, or Degree of the *Ecliptick* is in. If the *Star* or deg. of the *Ecliptick* be under the Horizon, turn the *Globe* about till 108 degrees of the *Equator* paſs through the *Meridian*, then will the *Star* or deg. of the *Ecliptick* be above the Horizon: Lift up then the Circle of Poſition (as before,) to the *Star* or deg. of the Ecliptick, and the number of degrees of the Quadrant of Altitude, the Circle of Poſition cuts on the *Eaſt* ſide, is the number of Circles of Poſition the *Star* was under the Horizon on the *Weſt* ſide; or ſo many degrees as the Circle of Poſition cuts on the Quadrant of Altitude in the Weſt-ſide the Horizon, is the number of the Circles of Poſition the *Star*, or degree of the Ecliptick, was under the Horizon on the Eaſt-ſide.

PROB. VII.

To find the Right Aſcenſions, *the* Oblique Aſcenſions, *and the* Declinations *of the* Planets.

EXamine the Right Aſcenſions and Declinations of thoſe Pricks, made to repreſent each Planet, in Prob. 1. of this Book; and work by them as you were directed to work by the *Sun*, in Prob. 26, 27, 28. of the Second Book.

PROB. VIII.

How to Direct *a* Figure *by the* Globe.

TO direct a Figure, is to Examine how many degrees of the Equinoctial are moved Eaſtwards or Weſtwards, while any Planet or Star in one Houſe comes to the Cuſp, or any other Point of any other *Houſe*.

When you would direct any *Promittor* to any *Hylegiacal* Point, examine the degree of the Equator at the Meridian; then turn about the Globe till the *Promittor* come to the *Hylegiacal* Point, and examine again the Degree of the Equator at the Meridian; and by ſubtracting the Leſſer from the Greater, you will have the number of degrees that paſſed through the Meridian, while the place of the *Promittor* was brought to the *Hylegiacal* Point; and that number of degrees ſhall be the Arch of Direction.

Example.

I would *direct* the Body of the *Moon* in our Figure aforeſaid, to *Medium Cœli*, or the Tenth Houſe: I find by the *Globe* 203 degrees 30 minutes of the Equator at the Meridian with the Tenth Houſe, and turning the *Globe* till the Prick made to repreſent the *Moon*, come to the Meridian, I find 227 degrees 20 minutes of the Equator come to the Meridian with it; therefore I ſubtract the Leſſer from the Greater, *viz.* 203 degrees 30 minutes, from 227 degrees 20 minutes, and have remaining 23 degrees 50 minutes.

This 23 degrees 50 minutes, ſhews that 23 Years 10 Months muſt expire, e'er the Effects promiſed by the Moons preſent Poſitions, ſhall operate upon the Signification of the Tenth Houſe.

If the Body of the *Moon* had been *directed* to any other Point than the Meridian or Horizon; you muſt have Elevated the Circle of Poſition to the Point propoſed; and have underproped it to that Elevation, and then have turned about the *Globe* till the Prick repreſenting the *Moon*, had come to the Circle of Poſition; and then the degrees of the Equator that ſhould have paſſed through the Meridian whiles this Motion was making, ſhould be the number of degrees of Direction; and ſignifie in Time as aforeſaid.

PROB. IX.

Of Revolutions; *and how they are found by the* Globe.

BY a Revolution, is meant the Annual Converſion of the *Sun* to the ſame Place he was in at the Radix of any Buſineſs. When you would find a Revolution by the Globe, firſt find the Right Aſcenſion of Mid-Heaven at the Radix of the Buſineſs, as by Prob. 26. of the Second Book, you were directed to find the Right Aſcenſion of the *Sun*; and to it, add 87 degrees for every Year ſince the Radix: Then Subtract 360 ſo oft as you can from the Whole, and the Remains ſhall be the Right Aſcenſion of Mid-Heaven for the Annual Revolution.

If you count the number of degrees of the Equator, contained between the Right Aſcenſion of the Mid-Heaven, and the Right Aſcenſion of the Sun, and convert that number of degrees into Time, by allowing for every 15 degrees 1 Hour of Time, it will ſhew, if the *Suns* Place be on the Weſtern-ſide of the Meridian, the number of Hours and Minutes Afternoon the Revolution ſhall happen on; but, if on the Eaſt-ſide the Meridian, the number of Hours and Minutes Beforenoon the Revolution ſhall happen on.

PROB. X.

How a Figure *of* Heaven *may be Erected by the* Revolution *thus found.*

SEEK the degree of Right Aſcenſion of Mid-Heaven, and bring it to the Meridian, ſo ſhall the Four Cardinal Points of the Globe, be the ſame with the Four Cardinal Points in Heaven, at the Time of the Revolution. The other Houſes are found by the Circle of Poſition; as in the firſt Probleme of this Book.

The End of the Fourth Book.

The

The Fifth BOOK.

Shewing the Practical Uſe of the GLOBES. Applying them to the Solution of GNOMONICAL PROBLEMES.

PRÆFACE.

DIALS *are of two Sorts*, Pendent, *and* Fixed, Pendent *are ſuch as are Hung by the Hand, and Turned towards the* Sun; *that by its Beams darting through ſmall Pin-holes made for that purpoſe, the Hour of the Day may be found. Theſe are of two Sorts*, Univerſal, *and* Particular.

Univerſal Dials, *are thoſe, commonly called* Equinoctial *or* Ring-Dials: *They are Uſed by Sea-men and Travellers, that often ſhift* Latitudes.

Particular, *are ſuch as are made, and only ſerve for Particular* Latitudes. *Of theſe Sorts are the ſeveral* Dials *deſcribed on* Quadrants, Cilinders, *&c.*

Fixed Dials *ſhall be the Matter of this Diſcourſe; and they are ſuch as are made upon Fixed Plains, and ſhew the Hour of the Day by a* Stile, *or* Gnomon, *made* Parallel *to the* Axis *of the* World.

Of

Of the ſeveral Kinds *of* Dyal Plains: *And how you may know them.*

A *Plain* in *Dyaling* is that Flat whereon a *Dyal* is Deſcribed.

There is ſome diſagreement among Old and Later Authors in the Naming of *Plains*: For ſome Name them according to the *Great Circle* in *Heaven* they *Lye* in, and others according to the *Situation* of the *Poles* of the *Plains*. Thus they which Name them according to the *Great Circle* in *Heaven* their *Plains* Lye in, Call that an *Horizontal Plain*, which others call a *Vertical Plain*, thoſe *Vertical Plains*, which others will Call *Horizontal*; and thoſe *Polar*, which others Call *Equinoctial*.

However they be Called it matters not, ſo you can but diſtinguiſh their Kinds, which with a little Conſideration you may eaſily learn to do: For remembering but upon what Grounds either the Older or Later Authors gave their *Plains* their Names, upon the ſame Grounds you may alſo learn to know them. I confeſs both ways admit of ſome juſt Exception againſt, for in the Older Rule, a *Plain* about the *Pole*, is called an *Equinoctial Plain*; when as to a ſudden apprehenſion it will Sound more Significant to Call it a *Polar Plain*, as Later Authors do: Again, Later Authors Call an *Horizontal Plain*, a *Vertical Plain*; when as it Sounds more Significant to Call it an *Horizontal Plain*, as Older Authors do: Becauſe it lies Flat upon the *Horizon*: But I ſhall give you the Names according to both Rules, and leave you to your liberty to accept of which you pleaſe.

Firſt therefore, you have an *Equinoctial Plain*, or otherwiſe called a *Polar Plain*. This *Plain* hath two *Faces*, Upper and Under: Theſe two *Faces* lye in the *Plain* of the *Equinoctial*, the Upper *Face* beholding the Elevated *Pole*, the Under *Face* the Depreſſed *Pole*.

2. An *Horizontal Plain*, otherwiſe called a *Vertical Plain*; it lies in the *Plain* of the *Horizon*, directly beholding the *Zenith*.

Erect Plains, otherwiſe called *Horizontal Plains*, are the Sides of Walls, and theſe are of ſeven Sorts, *viz.* 1. *Erect Direct Vertical*, *North* or *South*. 2. *Erect Direct*, *Eaſt* or *Weſt*. 3. *Erect Vertical Declining*. 4. *Erect Inclining Direct*. 5. *Erect Inclining Declining*. 6. *Erecting Reclining Direct*. 7. *Erect Reclining Declining*.

3. *Erect Vertical*, *North* or *South Direct*, otherwiſe Called

Direct North, or *South Horizontals*, behold the North or South *Directly*, and lye in the Eaſt or Weſt *Azimuth*.

4. Erect Direct Eaſt or Weſt, otherwiſe called Direct Eaſt or Weſt Equinoctials, behold the Eaſt or Weſt Directly, and lyes in the Plain of the Meridian, having its Poles in the Equinoctial.

5. Erect Vertical Declining Plains, otherwiſe called Declining Horizontals, do not behold the North or South Directly, but ſwerves from them ſo much as the Azimuth Parallel to their Plains, ſwerves or declines from them.

6. Erect Inclining Direct Plains, have the Upper-ſide of their Plains Inclining, or coming towards you, and their Plains do exactly behold either the Eaſt, Weſt, North, or South.

7. Erect Reclining Direct Plains, have the Upper-ſide of their Plains Reclining or falling from you, and their Plains exactly beholding either the Eaſt, Weſt, North, or South.

8. Erect Reclining Declining, or Erect Inclining Declining Plains, are thoſe Plains which are either Inclining or Reclining, but do not behold the Eaſt, Weſt, North, or South Directly, but ſwerve or decline more or leſs from them.

9. Polar Plains are Parallel to the *Axis* of the World, and to the *Meridians* that cuts the Eaſt and Weſt, or North and South Points of the Horizon.

All theſe Kinds of Plains have two Faces; the one beholding the North Pole with the ſame reſpect that the other beholds the South Pole; except the Equinoctial Plain, which becauſe neither Pole is Elevated, hath but one Face; yet that one contains as many Hour Lines as two other Faces.

Theſe two Faces, or Plains, will receive juſt 24 Hour-Lines, for the 24 Hour-Lines of Day and Night; for ſo much as the one Side or Face wanteth or exceedeth 12, the other Side ſhall either exceed or want of 12.

Every Dial Plain is Parallel to the Horizon of ſome Country or other, of the Earth: Therefore a Dial made for any Horizon of the Earth, may be Set to ſuch a Poſition, that it will ſhew you the Hour of the Day in your own Habitation; at leaſt for ſo long as the *Sun* continues upon that Plain.

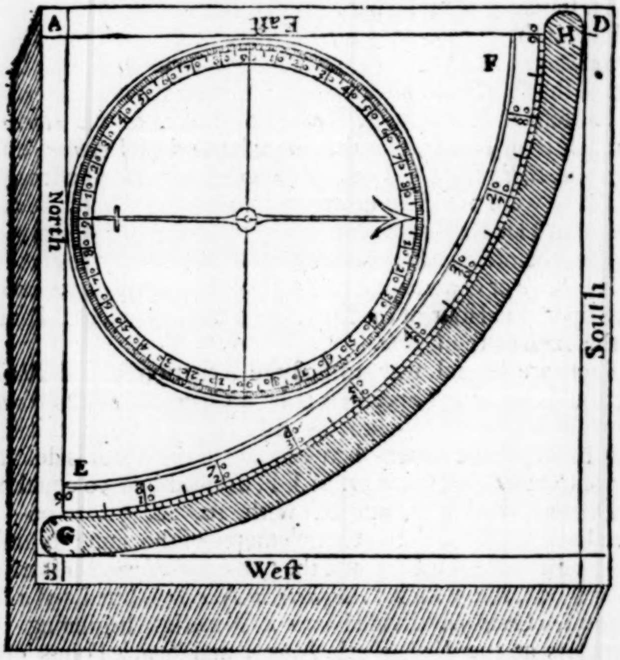
All Plains may be aptly demonſtrated by the Globe, by ſetting it correſpondent to all the Circles in Heaven, as by Prob. 2. of the Second Book; for if you imagine the Globe in that Poſition were preſt flat into the Plain of any Circle, that Flat ſhall repreſent a *Dyal plain*, which ſhall be Called after the Name of that Circle it is preſt into.

Thus if the *Quadrant of Altitude* be applyed to any Degree of *Azimuth*, and you imagine the *Globe* were preſt Flat to the edge of the *Quadrant of Altitude*, ſo much as that *Azimuth Declines* from the *Eaſt*, *Weſt*, *North*, or *South*, in the *Horizon*, ſo much ſhall that Flat on the *Globe* be ſaid to *Decline* either from the *Eaſt*, *Weſt*, *North*, or *South*. Or if you imagine, the *Globe* were preſt Flat down even with the *Plain* of the *Horizon*, that Flat ſhall repreſent an *Horizontal Plain*; becauſe as was ſaid before, the *Plain* lies in that Circle called the *Horizon*.

The *Style* or *Gnomon*, is that ſtraight Wyer that caſts the Shadow upon the Hour of the Day: It is always placed Parallel to the *Axis* of the *World*.

There are ſeveral ways to find the Situation of all *Plains*; but the Readieſt and Speedieſt is by a *Clinatory*. The *Clinatory* is made of a Square Board, as ABCD, of a good thickneſs, and the larger the better; between two of the Sides is deſcribed on the Center A a *Quadrant*, as E F, divided into 90 equal parts or Degrees, which are figured with 10, 20, 30, to 90; and then back again with the Complements of the ſame Numbers to 90: Between the *Limb* and the two *Semi-diameters* is made a Round Box, into which a *Magnetical Needle* is fitted, and a *Card* of the *Sea Compaſs*, divided into 4 Nineties, beginning their Numbers at the *Eaſt*, *Weſt*, *North*, and *South* Points of the *Compaſs*, from which Points the oppoſite Sides of the *Clinatory* receive their Names of *Eaſt*, *Weſt*, *North*, and *South*. Upon the *Center* A, whereon the *Quadrant* was deſcribed, is faſtened a *Plumb-line*, having a Plumbet of *Lead* or *Braſs* faſtened to the end of it, which *Plumb-line* is of ſuch Length, that the *Plumet* may fall juſt into the *Grove* G H below the *Quadrant*, which is for that purpoſe made of ſuch a Depth, that the *Plumet* may ride freely within it, without ſtopping at the Sides of it. See the *Figure* annexed.

With this *Clinatory* you may Examine the Situation of *Plains*: As if your *Plain* be *Horizontal*; it is *Direct*: And then for the true Situating your *Dyal*, you have only the true *North* and *South* Line to find: Which is done only by ſetting the *Clinatory* flat down upon the *Plain*, and turning it towards the Right or Left Hand, till you can bring the *North* Point of the *Needle* to Hang



juſt over the *Flower-de-luce*, for then if you draw a Line by either of the Sides Parallel to the *Needle*, that Line ſhall be a *North* and *South* Line. But herein reſpect muſt be had to the *Variation* of the *Compaſs* in the Place you make your *Dyal:* For if the *North* Point of the *Needle* ſwerves from the *North* Point of the *World*, then have you not a true *North* and *South* Line. But if in your Place there be no *Variation* of the *North* Point of the *Needle* from the *North* Point of the *World*, (as now it happens here at *London*) then the Line drawn by the Side of the *Clinatory* (as aforeſaid) ſhall be a true *North* and *South* Line.

But admit there be *Variation*, Having by Prob. 19. of the Third Book found the number of Degrees of this *Variation* towards the *Eaſt* or *Weſt*, Count the ſame number of Degrees from the *North* Point in the *Card* either to the *Eaſtwards* or *Weſtwards*; and note the Degree in the *Card* terminating at that Number, for that Degree ſhall be the *North* Point, and its Oppoſite Degree the *South* Point: 90 Degrees from it either way ſhall be the *Eaſt* and *Weſt* Points.

Therefore,whereas before you were directed to turn the *Clinatory*,till the *North* Point of the *Needle* point to the *Flower-de-luce* on the *Card*, you muſt now turn (or move) the *Clinatory*, till the *North* Point of the *Needle* Hang juſt over the Degree of *Variation* thus found; and then a Line drawn, as aforeſaid, by the Side of the *Clinatory* Parallel to the *Needle*, ſhall be a *North* and *South* Line, or (to ſpeak more properly) a *Meridional* Line.

You may find a *Merdian* Line ſeveral other ways, as, *Firſt*, If the *Sun Shine* juſt at Noon, hold up a *Plumb-line* ſo as the Shadow of it may fall upon your *Plain*; and that Shadow ſhall be a *Meridian* Line.

Secondly, on the Back-ſide the *Clinatory* deſcribe a Circle, and draw a Line through the *Center* to both ſides the Circumference; Croſs this Line with another Line at Right Angles in the Center, ſo ſhall the Circle be divided into four equal parts. Theſe four parts you muſt mark with *Eaſt*, *Weſt*, *North*, *South*, and divide each of them into 90 Degrees. In the Center of this *Plain* erect a ſtraight Wyer perpendicularly: When you would find a *Meridian* Line, examine by the 10 Prob. of the 2d Book, the *Amplitude* of the *Suns* Riſing or Setting from the *Eaſt* or *Weſt* Points, and waiting the juſt Riſing or Setting that Day, turn the Inſtrument about till the Shadow of the Wyer falls upon the ſame Degree from the *Eaſt* or *Weſt* the *Amplitude* is of, for then the *North* and *South* Line in the *Inſtrument*, will be the ſame with the *North* and *South* Line in *Heaven*.

Thirdly, by the *Suns Azimuth*: Find the *Azimuth* of the *Sun* by Prob. 22. of the Second Book: And at the ſame inſtant, turn the Inſtrument till the Shadow of the Wyer fall upon the Degree on the Inſtrument, oppoſite to the Degree of the *Suns Azimuth*, ſo ſhall the *Meridional* Line of the Inſtrument agree with the *Meridional* Line in *Heaven*.

You may the ſame way work by the *Azimuth* of any *Star*: Only, whereas the Shadow of the Wyer ſhould fall upon the oppoſite Degree aforeſaid, now you muſt place a *Sight* or Perpendicular upon that oppoſite Degree, and turn the Inſtrument about till the Wyer at the *Center*, the *Sight* in the oppoſite Degree of the *Stars Azimuth*, and the *Star* in *Heaven*, come into one ſtraight Line, ſo ſhall the *Meridian* Line of the Inſtrument, agree with the Meridional Line in Heaven.

Fourthly, It may be found by any *Star* Obſerved in the Meridian, if two Perpendiculars be erected in the Meridian Line of your Inſtrument, for then by turning the Inſtrument till the two Perpendiculars and the *Star* come into a ſtraight Line, the Meridian Line of your Inſtrument will be the ſame with the Meridian Line in *Heaven*. See more Ways in Mr. *Palmer* on the Planiſphere; Book 4. Chap. 7.

If your Plain either Recline or Incline, apply one of the Sides of your Clinatory Parallel, to one of the Semi-diameters of the *Quadrant* to the Plain, in ſuch ſort that the Plumb-line Hanging at liberty, may fall upon the Circumference of the *Quadrant*, for then the number of Degrees of the *Quadrant* comprehended between the Side of the *Quadrant* Parallel to the Plain and the Plumb-line, ſhall be the number of Degrees of Reclination, if the Center of the *Quadrant* points Upwards; or Inclination, if the Center points Downwards.

If your Reclining or Inclining Plain Decline, Draw upon it a Line Parallel to the Horizon, which you may do by applying the back ſide of the Clinatory, and Raiſing or Depreſſing the Center of the *Quadrant*, till the Plumb-line Hang juſt upon one of the Semi-diameters, for then you may by the Upper ſide of the Clinatory, draw an Horizontal Line, if the Plain Incline, or by the Under ſide, if it Recline. If it neither Incline nor Recline, you may draw an Horizontal Line both by the Upper and Under Sides of the Clinatory. Having drawn the Horizontal Line, apply the North ſide of the Clinatory to it, and if the North end of the Needle points directly towards the Plain, it is then a South Plain. If the North point of the Needle points directly from the Plain, it is a *North* Plain: But if it points towards the *Eaſt*, it is an *Eaſt*-Plain: If towards the *Weſt*, a *Weſt* Plain: If it do not point directly either *Eaſt*, *Weſt*, *North* or *South*, then ſo many degrees as the Needle declines from any of thoſe four Points, to any of the other of theſe four Points, ſo many degrees is the declination of the Plain, with reſpect (as aforeſaid) had to the Variation of the Compaſs.

Or if you find the Azimuth of the *Sun*, by its Altitude Obſerved juſt when its Beams are coming on or going off your Plain, that Azimuth ſhall be the Azimuth of your Plain.

Or you may erect a Wyer Perpendicularly on your Plain, and wait till the Shadow of that Wyer comes to the Perpendicular with the Horizon, which you may examine by applying a Plumb-line to it, for then the Shadow of the Plumb-line and the Shadow of the Perpendicular will be in one: Then taking the Altitude of the *Sun*, you may, by Prob. 22. of the Second Book, find its Azimuth, and thereby know in what Azimuth the Plain of your Dyal lies: For the Azimuth your Plain lies in, is diſtant from the Azimuth of the *Sun* juſt 90 degrees.

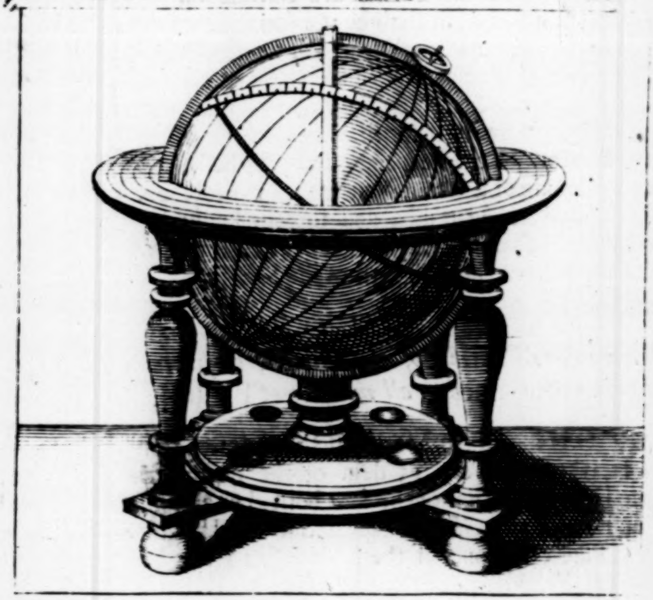
PROB. I.

How by one Poſition of the Globe, *to find the Diſtances of the* Hour-lines *in all manner of* Plains.

YOU may have Meridian Lines drawn from Pole to Pole, through every 15 deg. of the Equinoctial, to repreſent the Horary Motion of the *Sun* both day and night: And when the Pole of the *Globe* is Elevated to the Height of the Pole in any Place, and one of theſe Meridian Lines be brought to the Brazen Meridian, all the reſt of the Meridian Lines, ſhall Cut any Circle which you intend ſhall repreſent the Plain of a *Dyal*, in the number of degrees on the ſame Circle, that each reſpective Hour-line is diſtant from the Noon-line Point in the ſame Circle.

Thus if you ſhould enquire the diſtance of the Hour-lines upon an Horizontal Plain in *London*'s Latitude; The Pole of the *Globe* (as aforeſaid) muſt be Elevated 51½ degrees, and one of the Meridian Lines (you may chuſe the Vernal Colure) be brought to the Brazen Meridian, which being done, you are only to examine in the Horizon (becauſe it is an Horizontal Plain) at what diſtance from the Meridian (which in Horizontals is the Noon-line) the ſeveral Meridians drawn on the *Globe* interſect the Horizon, for that diſtance in Degrees, ſhall be the diſtance on a Circle divided into 360 degrees, that each reſpective Hour-line muſt have from the Meridian, or a Noon-line choſen in the ſame Circle: And Lines drawn from the Center of that Circle through thoſe degrees, ſhall be the Hour-lines of an Horizontal Plain.

If it be an Erect Direct *South* *Dyal* you enquire after; Keeping



ing the *Globe* in its former Poſition, apply the *Quadrant of Altitude* to the *Zenith*, and its lower end to the *Eaſt* Point of the *Horizon*, for then (as was ſhewed in the *Preface*) by imagining the *Globe* to be preſt Flat to the Graduated edge of the *Quadrant of Altitude*, that Flat ſhall be a *South Plain*, and the number of Degrees the *Meridian* Cuts in the *Quadrant of Altitude*, numbered from the *Zenith* Downwards, ſhall be the number of Degrees that each Hour Line ſhall be diſtant from the *Meridian* or Noon-line in a Circle of 360 Degrees; and Lines drawn from the Center of that Circle through thoſe Degrees, ſhall be the Hour Lines of Half the Day: The Hour Lines for the other Half of the Day, are of the ſame diſtance from the Noon-line, with theſe; only they muſt be placed on the other ſide the Noon-line.

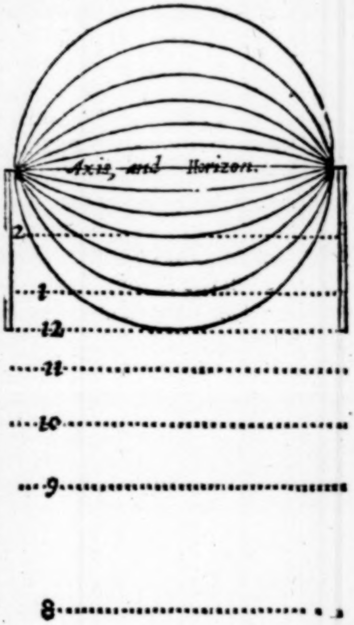
If your Plain be not *Direct*, but *Declines Eaſt* or *Weſt*, you muſt number the *Declination Eaſtwards* or *Weſtwards* reſpectively, in the Degrees of the *Horizon*, and (the *Quadrant of Altitude*

Altitude ſcrewed to the *Zenith*, (as aforeſaid,) bring the lower end of the *Quadrant of Altitude* to the ſaid degrees of *Declination*, and the number of degrees cut by the *Meridians* in the *Quadrant of Altitude*, (numbred downwards,) is the number of degrees that the Hour-Lines are diſtant from the Noon-Line, in a Circle of 360 degrees: And Lines drawn from the Center of that Circle through thoſe deg. be the Hour-Lines of half the Day. And if you turn about the *Quadrant of Altitude* upon the *Zenith* Point, till the lower end of it come to the deg. of the *Horizon*, oppoſite to the deg. of *Declination* found before, the *Meridian* Lines on the *Globe*, (as before,) ſhall cut the *Quadrant or Altitude* in the number of degrees (counted downward,) that each Hour-Line is diſtant from the other ſide the Noon Line: And Lines drawn from the Center of that Circle through thoſe degrees, ſhall be the Hour-Lines of the other half of the Day.

If your Plain *Decline*, and alſo *Recline* or *Incline*, you muſt uſe the *Gnomonical Semi-Circle*, deſcribed in Prob. 12. which muſt be Elevated on the *Quadrant of Altitude*, when it is ſet to the *Declination* (as by the former Rule,) according to the Complement of *Reclination*, or *Inclination*. But if your Plain be *Direct*, and *Recline*, or *Incline*, it muſt be ſet to the *Meridian*, and the *Meridians* on the *Globe*, ſhall cut that Semi-Circle in the number of degrees counted from the *Quadrant of Altitude*, if the Plain *Declines*, or from the *Brazen Meridian*, if it be *Direct*, that the ſeveral Hour-Lines are diſtant from a Line Perpendicular to an Horizontal Line, in a Circle divided into 360 Degrees: And Lines drawn from the Centre through thoſe degrees, ſhall be the Hour-Lines of ſuch *Reclining* or *Inclining* Plains.

If your Plain be an *Eaſt* or *Weſt*, either *Direct* or *Declining*; or an *Equinoctial* Plain (for they are upon the matter all one,) you may better conceive how they are to be made, then make them by the *Globe*. And for the help of your Fancy herein, take Mr. *Blagrave*'s Conceit, who in his Book 6. Chap. 8. very properly demonſtrates the Rules for projecting the Hour-Lines on theſe Plains. He propoſes to take 12 Wyers bowed into exact Circle, all of equal Diameter, and ſet together at equal diſtance one from another, in two oppoſite Points, as in two Poles, and to have a ſtraight Line to paſs from one Pole to another, as an *Axis*. Theſe 12 Wyers ſhall repreſent 24 *Meridional* Semi-Circles; Or indeed, they may repreſent the *Globe* it ſelf, containing 24 *Meridional*

ridional Semi-Circles to be deſcribed on the *Globe*, as aforeſaid; and if you place the *Horizon* of the *Globe* *Horizontal*, and the *North* and *South* Points of the *Globe*, towards the *North* and *South* Points in *Heaven*, and bring one of theſe Wyer *Meridians* directly under the *Brazen Meridian*, and the *Axis* of this Wyer-*Globe*, in the Plain of the Horizon. and faſten a Thread in the middle of the *Axis*, that Thread drawn from the middle of the *Axis* by every one of theſe Wyers, ſhall, if prolonged till it touch an *Eaſt* and *Weſt* Line, drawn directly Under, or Over the Points *Zenith* or *Nadir*, point out on that Eaſt and Weſt Line, the diſtances of each Hour-line from the 12 a Clock Line; and Lines drawn at Right Angles through that *Eaſt* and *Weſt* Line, ſhall be the Hour-Lines of an *Eaſt* or *Weſt* Plain, or of an *Equinoctial* Plain.



The moving this Thread from Wyer to Wyer, repreſents the Motion of the *Sun*, which as it paſſes over all the *Meridians*, cauſes the Shadow of that Meridional Semi-circle which it is directly Over, and the *Axis*, and the Meridional Semi-circle, directly Oppoſite to the Upper Meridional Semi-circle, to fall all into one ſtraight *Line*; and upon what Point in the *Eaſt* and *Weſt* Line (mentioned before,) that Shadow-line ſhall fall, is marked out by the Application of the Thread, as aforeſaid; and is an Hour-line on any of the aforeſaid Plains.

If you underſtand this Probleme rightly, you already know how to draw the Hour-lines upon all manner of *Plains*, and need no further Inſtructions, yet partly fearing a young Student ſhould not clearly underſtand theſe Rules, and partly doubting (becauſe other Authors have been more Copious upon this Subject) that I ſhould be cenſured to be too ſparing of my Pains, if I ſhould lightly touch ſo Eminent a Doctrine as *Dialling* is: Therefore I ſhall more diſtinctly handle *Dialling* by the *Globe*, according to the Way or Method that other Authors have Uſed, and that after ſo plain a manner, as poſſibly my Genius can deviſe.

PROB. II.

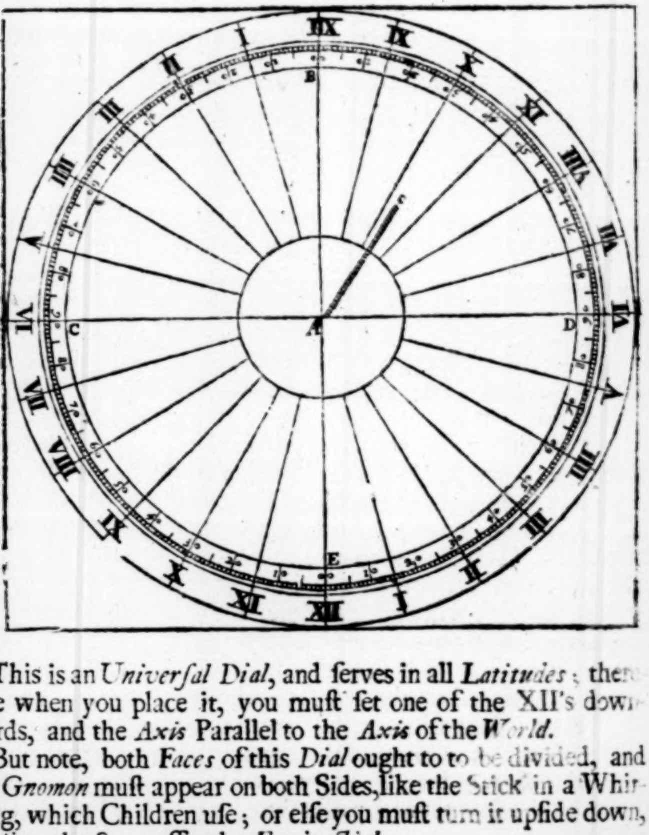
To make an Equinoctial Dial.

DEſcribe a Circle, on a Square Board or Plain, as BCED, and through A, the Center thereof, draw a ſtraight Line Parallel to one of the Sides, as B E; croſs that ſtraight Line with another ſtraight Line, as C D at Right Angles; ſo ſhall the Circle be divided into 4 equal parts. Divide each of theſe four equal parts into 90 Degrees, as in the Figure. This Circle ſhall repreſent the Horizon.

Erect a Wyer exactly perpendicular to the Center of the Plain, and that Wyer ſhall be the *Gnomon*, or *Style* of the *Dial*.

Then Elevate one of the Poles of your *Globe* into the *Zenith*, and bring the Equinoctial *Colure* to the Meridian. And becauſe in every Hours Time, 15 degr. of the Equator paſſes through the Meridian in Heaven, therefore turn the *Globe* till 15 *Degr.* of the Equator paſſes through the Meridian of your *Globe*; ſo ſhall the *Colure* paſs by 15 *Degr.* of the Horizon alſo. Therefore from the Center of your Plain, draw ſtraight Lines through 15 *Degr.* from one of the Semi-diameters both ways, and thoſe ſtraight Lines ſhall be two Hour-Lines. Then turn the *Globe* till 15 *Degrees* more of the Equator paſs through the Meridian, and you will find, as before, the *Colure* paſs by 15 *Degr.* more of the Horizon; therefore on your Plain, number 15 *Degrees* further, beyond both the former *Lines*, and from the Center draw ſtraight Lines through both thoſe 15 *Degrees*, and they ſhall be two Hour-Lines more. For all the other Hour-Lines, turn the *Globe* till 15 *Degrees* of the Equator, at a time paſs through the *Meridian*, as before, and you will find, that for every 15 *Degr.* of the Equator that paſſes through the Meridian, the *Colure* will paſs through 15 *Degrees* of the Horizon: Therefore thoſe

Hour-Lines muſt be drawn from the Centre, according to the Succeſſion of every 15 *Degrees* on your *Plain.* Having drawn the Hour-Lines, you may ſet Figures on them, beginning to number your Hour Lines from one of the Diameters, marking it with XII, and the next Hour-Line to the Left Hand with I, and the next II, the next III, &c. to XII: And begin again with I, II, III, &c. till you come to the other XII, where you began; and then your *Dial* is finiſhed. See the *Figure.*



This is an *Univerſal Dial*, and ſerves in all *Latitudes*; therefore when you place it, you muſt ſet one of the XII's downwards, and the *Axis* Parallel to the *Axis* of the *World.*

But note, both *Faces* of this *Dial* ought to to be divided, and the *Gnomon* muſt appear on both Sides, like the Stick in a Whirligig, which Children uſe; or elſe you muſt turn it upſide down, ſo oft as the *Sun* paſſes the *Equinoctial.*

PROB.

PROB. III.

To make an Horizontal Dial.

DEſcribe a Circle on your Plain, as CBDE, and through the Center A of that Circle draw a Meridian, or Twelve a Clock Line) as BE; croſs that Line at Right Angles, with another Line, as CD; ſo ſhall your Circle be divided into four equal parts; divide each of theſe four parts into 90 degrees; ſo ſhall the whole be divided into 360. Theſe 360 degrees repreſent the 360 degrees of the Horizon, which a Meridian Line drawn through the place of the *Sun*, runs through in every 24 Hours: The Motion of which *Meridian* Line through the Degrees of the Horizon, is Regular in a Parallel Sphere; for in equal Time. it moves an equal Space throughout the whole Circle, *viz.* it will paſs through 15 Degrees of the Horizon in one Hours Time, (or which is all one,) whiles 15 Degrees of the Equator paſſes through the *Meridian*, as was ſhewed in the laſt *Probleme:* But in an *Oblique Sphere*, its Motion through the Horizon is Irregular, and that more or leſs, according to the more or leſs *Obliquity of the Sphere*; for far *Northwards* or *Southwards* you may ſee this Meridian Line paſs through 40, 50, yea, 60 degrees of the Horizon in one Hours Time, *viz.* whiles 15 Degrees of the Equator paſs through the Meridian; but in another Hours Time, you will ſcarce have 4 or 5 Degrees paſs through the Horizon, whiles 15 Degrees of the Equator paſs through the Meridian.

But that you may know the Motion of the *Sun* (repreſented by this Meridian Line,) through the Horizon in all *Latitudes*; Elevate the Pole to the *Elevation* of your Place, and chuſe inſtead of a Meridian Line through the Place of the *Sun*, the *Vernal Colure* to be your Meridian Line; both becauſe it is moſt viſible, and becauſe from thence the degrees of the Equator are begun to be numbered, ſo that whatſoever Decimal Degree of the Equator you light on at the Meridian, or elſewhere, you will find its number from that *Colure* already ſet down to your Hand, without either Adding to, or Subtracting from it. Bring this *Colure* therefore to the Meridian, and the Index of the Hour Circle to 12 in the Hour Circle. Then turn the *Globe*

Weſtwards,and ſo oft as 15 degrees of the *Equator* paſſes through the *Meridian*, ſo oft you muſt examine what degree of the *Horizon* the *Vernal Colure* cuts; and thoſe degrees and minutes ſo cut by the *Vernal Colure*, muſt be found in the Circle CBDE, beginning your Account or Reckoning at B towards D, and markt with Pricks; through which Pricks, you muſt draw Lines from the Center A, and thoſe Lines ſhall be the Hour-Lines Afternoon. Then bring the *Colure* to the *Meridian* again, to find the Forenoon Hour-Lines, and turn the *Globe Eaſtwards*, and ſo oft as 15 degrees of the *Equator* paſſes through the *Meridian*; ſo oft you muſt examine what degrees of the *Horizon* the *Vernal Colure* cuts; and thoſe degrees and minutes ſo cut by the *Vernal Colure*, muſt be found in the Circle CBDE, beginning your reckoning from B towards C, and markt with Pricks: Through which Pricks you muſt draw Lines from the Center A, and thoſe Lines ſhall be the Forenoon Hour-Lines.

Theſe Hour-Lines muſt be markt from the *Meridian* Line, *viz.* the Line A B, which is the 12 a Clock Line towards D, with I,II,III, *&c.* till you have numbred to the Hour of *Sun*-ſet (found by Prob. 7. of the Second Book,) the Longeſt Day, and from the *Meridian* Line towards C with XI, X, IX, *&c.* till you have numbred to *Sun*-riſing the Longeſt Day.

The *Style* muſt be placed in the Center, and Elevated ſo many degrees above the Plain, as the Pole is Elevated above the *Horizon* of the Place.

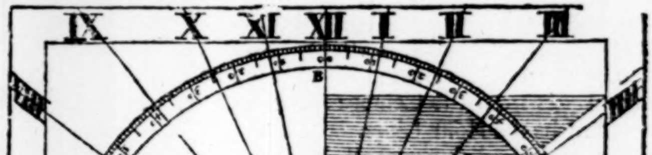
Example of the Whole.

I would make an *Horiztontal Dial* for *London's Latitude:* Therefore I Elevate the *North Pole* 51½ Degrees above the *Horizon*, and bring the *Vernal Colure* to the *Meridian*, and the *Index* of the *Hour-Circle* to 12 on the *Hour-Circle*.

And turning the *Globe Weſtwards*, till the *Index* points to	1	a Clock, or till 15 deg. of the *Equator*, paſs through the *Meridian*; I find the *Colure* cut the *Horiz.* in	11.40	from the *Meridian*.
	2		24.15	
	3		38. 4	
	4		53.36	
	5		71. 6	
	6		90.	

Theſe are the diſtances of the Hour-Lines from Noon till 6 at Night; and to theſe diſtances on the Plain (counting from B towards

wards D,) I make Pricks, and from the Center I draw Lines through theſe Pricks; and theſe Lines are the Hour-Lines from 12 to 6 Afternoon. But the *Sun* in the Longeſt Day ſhines till paſt 8 at Night, as you may find by Prob. 48. of the Second Book; therefore here wants the two Evening Hour-lines; which tho' they may be found after the ſame way I found the former, *(viz.* by continuing the turning the *Globe Weſtwards*,*)* yet, that I may the ſooner reduce my *Work* to the *Plain*, I count the number of *Degrees* between the 7 a Clock Line and the 5 a Clock Line in the Circle on the *Plain*; for the ſame number of *Degr.* counted from D towards E, is the diſtance of the 7 a Clock Hour-Line from the 6 a Clock Hour-Line; and the number of *Degr.* contained between the 6 a Clock Hour-Line and the 4 a Clock Hour-Line, is the diſtance of the 8 a Clock Hour-Line from the 6 a Clock Hour-Line.



Or, I need not draw the 7 and 8 a Clock Hour-Lines, till I have drawn the Forenoon Hour-Lines; for then, by laying the edge of a Ruler (that will reach through the oppoſite ſide of the Plain,) to the Morning 7 and 8 a Clock Hour-Lines, I may by the ſide of that Ruler, draw Lines from the Center through the oppoſite ſide of the Plain, and thoſe Lines ſhall be the 7 and 8 a Clock Hour-Lines Afternoon.

Having thus all the Afternoon Hour-Lines, I bring the *Vernal Colure* to the *Meridian* again; ſo ſhall the *Index* again point to 12. Therefore, as before, I turned the *Globe Weſtwards*; ſo now

turning it *Eaſtwards*, till the *Index* points to	11	a Clock, or till 15 deg. of the *Equator* paſs through the *Meridian*, I find the *Colure* Cut the *Horizon* in	11.40	from the *Merid.*
	10		24.15	
	9		38. 4	
	8		53.36	
	7		71. 6	
	6		90.	

Theſe are the diſtances of the Hour-Lines from Noon to *6* a Clock in the Morning; and theſe diſtances, I ſeek in the Circle of the Plain, (counting from the Noon-Line B towards C,) and mark them with Pricks; through which Pricks (as before,) I draw Lines from the Center to the outſide Plain; and thoſe Lines ſhall be the Hour-Lines.

Or, having the diſtance of all the Afternoon Hour-Lines, I have alſo the diſtance of all the Forenoon Hour-Lines from the *Meridian*; as you may ſee, by comparing the two former Tables: For the 1 a Clock Hour-Line Afternoon, is equidiſtant from the *Merid.* or Noon-Line, with the 11 a Clock Hour-Line before Noon, *viz.* they are both 11 deg. 40 minutes diſtant from the Noon-Line, and the 2 a Clock Hour-Line Afternoon, is from the Noon-Line, equidiſtant with the 10 a Clock Hour-Line Before-noon; for they are both 24 deg. 15 minutes diſtant from the *Merid.* or Noon-Line; and ſo all the other Morning Hour-Lines are diſtant from the Noon-Lines, by the ſame ſpace that the ſame number of Afternoon Hour-Lines (told from the *Meridian* on the contrary ſide the Noon-Line.) are diſtant from *Meridian.*

Whence it follows, that ſince (as aforeſaid) the ſame number of Hour-Lines after *6* at Night, and before *6* in the Morning, have the ſame diſtance from the *6* a Clock Line, that the ſame number of Hour-Lines before *6* at Night, and after *6* in the Morning have from the *6* a Clock Line; and ſince the ſame number of Hour-

Lines before Noon are equidiſtant from the *Meridian* or Noon Line by the ſame ſpace of Degrees that the ſame number of Hour-lines Afternoon are, it follows (I ſay) that having found the diſtance of the Six Hour-lines either before or after Noon, you have alſo given the diſtance of all the other hour-lines.

If you will have the half Hour-lines placed on your *Dyal*, you muſt turn the *Globe* till the *Index* points to every half Hour in the Hour-circle, as well as to the whole, and examine the Degrees of the *Horizon* Cut by the *Vernal Colure*, as you did for the whole Hours; and in like manner transfer them to your *Plain*.

Having thus drawn all the Hour-lines, I count from the Noon-line 51½ Degrees, the Elevation of the *Pole* here at *London*; and from the Center A, I draw a ſtraight Line, as A F through theſe 51½ Degrees for the *Gnomon* or *Style*, and prolong it to the fartheſt extent of the *Plain*: From this *Gnomon* or *Style* I let fall a Perpendicular upon the Noon-line as F G (this Perpendicular is called the *Subſtyle*) and this Perpendicular and its Baſs (which is the Noon-line) and Hypothenuſa (which is the *Gnomon*) ſhall make a Triangle, which being erected upon the Baſe, ſo as the *Subſtyle* may ſtand Perpendicular to the *Plain*, the Hypothenuſa A F ſhall be the *Gnomon*, and be Parallel to the *Axis* of the *World*; and caſt a ſhadow upon the Hour of the Day.

PROB. IV.

To make an Erect Direct South Dyal.

DRaw on your *Plain* an *Horizontal* Line as C A D, as was ſhewed in the *Preface*: In the middle of this Line (as at A) deſcribe as on a Center the Semi-circle C B D: From the Center A let fall a Perpendicular, which ſhall divide the Semi-Circle into two *Quadrants*, each of which *Quadrants* you muſt divide into 90 Degrees. Then Rectifie the *Globe*, *Quadrant of Altitude*, *Colure* and *Hour-Index*, thus, Elevate the *Pole* of the *Globe* to the *Latitude* of your place, and ſcrew the *Quadrant of Altitude* to the *Zenith*. Then bring the *Vernal Colure* to the *Meridian*, and the *Index* of the *Hour-circle*, to the Hour of 12 in the *Hour-circle*, ſo ſhall your *Globe*, *Quadrant of Altitude*, *Colure*, and *Hour-Index* be Rectified. And thus you muſt always Rectifie them for the making of moſt ſorts of *Dyals* by the

Globe. Then to make an *Erect Direct South Dyal*, Bring the lower end of the *Quadrant of Altitude* to the *Weſt* Point of the *Horizon*; and turn the *Globe Weſtwards* till the Index points to all the Hours Afternoon; and examine in what numbers of Degrees from the *Zenith* the *Colure* Cuts the *Quadrant of Altitude* when the *Index* Points to each Hour: for a Line drawn from the Center A through the ſame number of Degrees reckoned from the Perpendicular A B (which is the 12 a Clock Line) towards D on the *Plain*, ſhall be the ſame Hour-Lines the *Index* points at.

Thus in our *Latitude*, *viz*, 51½ Degrees the *Vernal Colure* being brought to the *Meridian* and the *Index* to 12,

If you turn the *Globe Weſtwards*, till the *Index* Points to	1	a Clock, or till 15 Deg. of the *Equator* paſs through the *Meridian*, the *Colure* will Cut the *Quad. of Alt.* in	9.18	counted from the *Zenith*.
	2		19.15	
	3		32. 5	
	4		48. 0	
	5		67. 4	
	6		90.	

And theſe are the diſtances of the afternoon Hour lines, which you muſt transfer to the *Eaſt* ſide of your *Plain*, *viz*. from B towards D; and draw Lines from the Center A through theſe diſtances; and theſe Lines ſhall be your After Noon Hour-Lines.

Note (once for all) when the *Colure* goes off that Circle you examine the Hour diſtances in, the *Sun* will Shine no longer upon that Plain; as in this example, the *Colure* goes off the *Quadrant of Altitude* at 6 a Clock, therefore the *Sun* will not Shine longer than till 6 a Clock upon this Plain.

The Hour-Lines before Noon have the ſame diſtance from the *Meridian* that the After Noon Hour-Lines have, as was ſhewed in the laſt Probleme: Only they muſt be counted from B towards C, and drawn on the *Weſt* ſide the Noon-Line.

Otherwiſe.

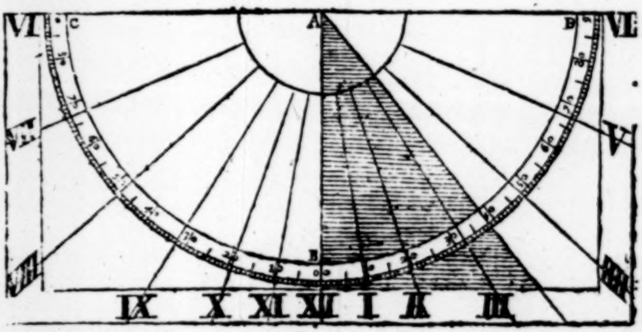
You may reduce all *Verticals* into *Horizontals*; if you Elevate the *Pole* of the *Globe* to the *Complement* of the *Latitude* of your Place; and bring the *Vernal Colure* to the *Meridian* under the Horizon, and the *Index* of the H*our Circle* to 12; and turn the *Globe Weſtwards*, for as the *Index* paſſes through every Hour on the *Hour-circle*, the *Colure* ſhews in the *Horizon* the diſtance of the ſeveral Afternoon Hour-lines from the *Meridian* or 12 a Clock-line, in the *Circle* on your *Plain*, numbred from B to D: And Lines drawn from the Center through theſe diſtances on your *Plain*, ſhall be the Afternoon Hour-lines of your *Dyal*.

Example.

London's Latitude is 51½ Degrees, its *Complement* to 90 is 38½. Therefore I Elevate the *Pole* 38½ Degrees above the *Horizon*, and bring the *Vernal Colure* to the *Meridian* under the *Horizon*, and the *Index* of the Hour-*circle* to 12 on the Hour *Circle*. Then

Turning the *Globe Weſtwards*, till the *Index* points to	1	a Clock: or till 15 Deg. of the *Equator* paſs through the *Meridian*; I find the *Colure* Cut the *Horizon* in	9 18	from the interſection of the *Meridian* and the *Horizon*, as in the former Table.
	2		19.15	
	3		32. 5	
	4		48. 0	
	5		67. 0	
	6		90.	

And theſe are the diſtances of the 6 Hours-lines from the *Meridian*; as you may ſee in this Figure.



By this *Example* you may ſee it is eaſy to reduce *Verticals* into *Horizontals*: And *Horizontals* into *Verticals*: For this *Erect Direct South Dyal* is an *Horizontal Dyal* to thoſe People that Inhabit 90 Deg. from Us, *viz.* in the *South Latitude* of 38½ Deg.

Then make a Triangle, whereof the Noon Line ſhall be

Baſe: From it count the *Complement* of the *Poles Elevation*, viz. 38½ Degrees, and through them draw the Line A F, from the Center A which ſhall be the Hypothenuſa; then let fall a Perpendicular upon the Noon Line A B, ſo is your Triangle made. If this Triangle be erected perpendicularly upon the Baſe or Noon Line, the Hypothenuſa A F ſhall ſtand parallel to the *Axis* of the *World*, and caſt a Shadow upon the Hour of the Day.

PROB. V.

To make an Erect Direct North Dyal.

IF the *Erect Direct South Dyal* were turned towards the *North*, and the Line C A D were turned downwards, and the Line marked with 7 be now marked with 5, and the Line 8 with 4, and the Line 5 with 7, and the Line 4 with 8, then have you of it a *North Erect Direct Dyal*.

All the other Hour Lines in this *Dyal* are Uſeleſs, becauſe the *Sun* in our Latitude Shines on a *North Face* the longeſt Day only before 6 in the Morning, and after 6 at Night.

PROB. VI.

To make an Erect Direct Eaſt Dyal.

THeſe ſorts of *Dyals* may better be demonſtrated than made by the *Globe*; unleſs the *Axis* of your *Globe* were acceſſible, as in the *Wyer-Globe*, ſpecified in Prob. 1. of this Book; therefore when you would make an *Eaſt* or *Weſt-Dyal*, or a *Polar-Dyal*.

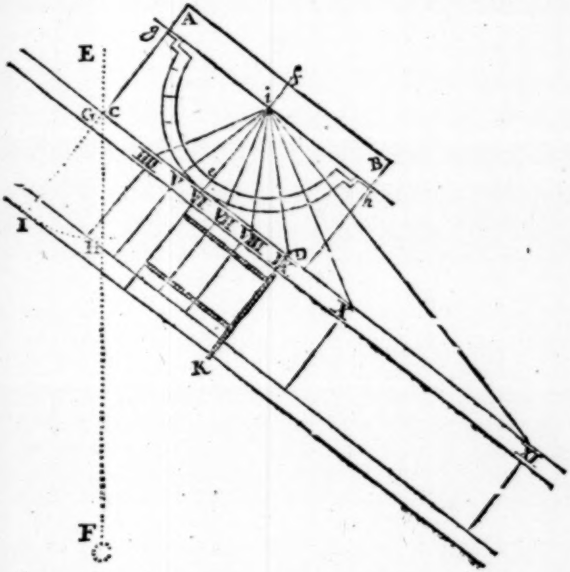
Provide a ſquare Board; as A B C D, draw the ſtraight Line *e f* upon it parallel to the ſides A C, and B D, and juſt in the middle between them: Croſs this ſtraight Line at Right Angles with another ſtraight Line, as *g h*, quite through the Board.

Upon this Board with a little Pitch or Wax faſten the Semi-*Circle of Poſition*, ſo as both the *Poles* thereof may lie in the Line *g h*, and the middle of the Semi-Circle marked 00 may lie upon the Line *e f* ſo ſhall *i* be the Center of the Semi-*Circle of Poſition*

In this Center make a ſmall Hole through the Board, fit to receive a Wyer or a Nail: So may you with the *Circle of Poſition* thus fitted, and the ſide C D applied to a Line of *Contingence* Elevated to the Height of the *Equinoctial*, draw Lines from the Center through every 15 Degrees of the *Circle of Poſition*, and by continuing them interſect the Line of *Contingence* in the points from whence the Hour Lines of an *Eaſt* or *Weſt Dyal* is to be drawn.

Example.

would make an *Erect Direct Eaſt Dyal* for *London*'s *Latitude*. Therefore I faſten a *Plumb-line* a little above the place



on the Wall where I intend to make my *Dyal*, and wait till it Hangs quietly before the Wall: Then if the Line be rubbed with Chalk (like a *Carpenters* Line) I may by holding the *Plumbet* end cloſe to the Wall, and ſtraining it pretty ſtiff, ſtrike with it a ſtraight line as *Carpenters* do. This line ſhall be a Perpendicular as E F: I chuſe a convenient point in this Perpendicular, as at G, for a Center: Whereon I deſcribe an occult Arch as H I, this Arch muſt contain the number of Degrees of the Elevation of the *Equinoctial* counted between H and I, (which in our *Latitude* is 38½) Therefore in a *Quadrant* of the ſame *Radius* with the occult Arch I meaſure 38½ Degrees, and ſet them off in the *Plain* from H in the Perpendicular to I: Then from I to the Center G in the Perpendicular, I draw the Prick-line I G, and this Line ſhall repreſent the *Axis* of the *World:* I croſs this *Axis* at Right Angels with the Line G K, and draw it from G to K, ſo long as I poſſibly can: This Line ſhall be the *Contingent-line*. I find a convenient place in this *Contingent-line*, as at VI. to which I apply the ſide of the Board C *e* D, ſo as that the point *e* may ly juſt upon VI in the *Contingent-line*; and having a Thred faſtned in the Center of the Semi-*circle of Poſition*, I draw that Thred ſtraight over the firſt 15 Deg. of the *Circle of Poſition*, numbred from *o* towards *h*, and where the Thred Cuts the *Contingent-line* I make a Mark, for that Mark ſhall be the Mark for the 7 a Clock Line. From thence I remove the Thred to 30 Degrees of the Semi-circle, and draw it through the *Contingent-line*, and where it Cuts the *Contingent-line*, there ſhall be the Mark for the 8 a Clock-line. From thence I remove the Thred to 45 Degrees of the Semi-circle and draw it through the *Contingent-line*, and where it Cuts the *Contingent-line* there ſhall be the Mark for the 9 a Clock-line. From thence in like manner I remove the Thred to 60 and 75, and where the Thred Cuts the *Contingent-line* ſhall be the Mark for 10 and 11 a Clock-Lines. The 12 a Clock-line cannot be drawn on this *Plain*, as you may ſee, if you apply the Thred to 90 Degrees, for though you ſhould draw it out never ſo far, yet would it never touch the *Contingent-line*, becauſe it is Parallel to the Line *g h*, and Lines Parallel never meet.

But becauſe in our *Latitude*, the *Sun* Riſes before 4 in the Morning, therefore two Hour-lines are yet wanting, *viz.* 5 and 4, which I may find either by applying the Thred firſt to 15, and next to 30 Degrees from *o* towards *g* in the Semi-circle, and ſo Marking where it Cuts the *Contingent-line*, as before: Or elſe by transferring the diſtance of the ſame number of Hour-Lines from the 6 a Clock-line already drawn on the ſide *e h*, to the ſide *e g*, as in Prob. 2. of this Book is more fully ſhewed.

Having thus Marked out on the *Contingent-line* the diſtances of each Hour, I draw a Line parallel to the *Contingent-line*, and draw Lines from every Hour Markt on the *Contingent* to croſs the *Contingent-line* at Right Angles, and continue each Line to the Line parallel to the *Contingent*; and theſe Lines ſhall be the Hour Lines of an *Eaſt Plain.* To theſe Hour Lines I ſet Figures, as in the *Scheme* may be ſeen.

The *Style* DK of this *Dyal* (as well as of others) muſt ſtand parallel to the *Axis* of the *World*: It muſt be alſo parallel to all the Hour Lines, and ſtand directly over the 6 a Clock Line, and that ſo high as in the diſtance between the Center of the Semi-*Circle of Poſition* and the point where the 6 a Clock Line Cuts the *Contingent-line*: Or (which is all one) at ſuch an Height as when it is laid Flat down upon the *Plain* it may juſt reach the 9 a Clock Line.

PROB. VII.

To make an Erect Direct Weſt Dyal.

AN *Erect Direct Weſt Dyal* is the ſame in all reſpects with an *Erect Direct Eaſt Dyal*; only as the *Eaſt* ſhews the Fore-noon Hours, the *Weſt* ſhews the Afternoon-Hours.

Thus if you ſhould draw the *Eaſt Dyal* on any tranſparent *Plain*, as on Glaſs, Horn, or an oyled Paper, on the one Side will appear an *Eaſt Dyal*, and on the other a *Weſt*; only the Figures (as was ſaid before) muſt be changed; for that which in the *Eaſt Dyal* is 11, in the *Weſt* muſt be 1: that which in the *Eaſt Dyal* is 10, in the *Weſt* muſt be 2: that which in the *Eaſt Dyal* is 9, in the *Weſt* muſt be three: &c.

PROB. VIII.

To mark a Polar Dyal.

POlar *Dyals* are *Horizontal Dyals* under the *Equinoctial*: They are of the ſame kind with *Eaſt* and *Weſt Dyals*; Only whereas *Eaſt* and *Weſt Dyals* have but the Hour Lines of Half the Longeſt Day deſcribed on them, theſe have all the Hour ſtraight line as *Carpenters* do. This line ſhall be a Perpendicular as E F: I chuſe a convenient point in this Perpendicular, as at G, for a Center: Whereon I deſcribe an occult Arch as H I, this Arch muſt contain the number of Degrees of the Elevation of the *Equinoctial* counted between H and I, (which in our *Latitude* is 38½) Therefore in a *Quadrant* of the ſame *Radius* with the occult Arch I meaſure 38½ Degrees, and ſet them off in the *Plain* from H in the Perpendicular to I: Then from I to the Center G in the Perpendicular, I draw the Prick-line I G, and this Line ſhall repreſent the *Axis* of the *World*: I croſs this *Axis* at Right Angels with the Line G K, and draw it from G to K, ſo long as I poſſibly can: This Line ſhall be the *Contingent-line*. I find a convenient place in this *Contingent-line*, as at VI. to which I apply the ſide of the Board C *e* D, ſo as that the point *e* may ly juſt upon VI in the *Contingent-line*; and having a Thred faſtned in the Center of the Semi-*circle of Poſition*, I draw that Thred ſtraight over the firſt 15 Deg. of the *Circle of Poſition*, numbred from *o* towards *h*, and where the Thred Cuts the *Contingent-line* I make a Mark, for that Mark ſhall be the Mark for the 7 a Clock Line. From thence I remove the Thred to 30 Degrees of the Semi-circle, and draw it through the *Contingent-line*, and where it Cuts the *Contingent-line*, there ſhall be the Mark for the 8 a Clock-line. From thence I remove the Thred to 45 Degrees of the Semi-circle and draw it through the *Contingent-line*, and where it Cuts the *Contingent-line* there ſhall be the Mark for the 9 a Clock-line. From thence in like manner I remove the Thred to 60 and 75, and where the Thred Cuts the *Contingent-line* ſhall be the Mark for 10 and 11 a Clock-Lines. The 12 a Clock-line cannot be drawn on this *Plain*, as you may ſee, if you apply the Thred to 90 Degrees, for though you ſhould draw it out never ſo far, yet would it never touch the *Contingent-line*, becauſe it is Parallel to the Line *g h*, and Lines Parallel never meet.

But becauſe in our *Latitude*, the *Sun* Riſes before 4 in the Morning, therefore two Hour-lines are yet wanting, *viz.* 5 and 4, which I may find either by applying the Thred firſt to 15, and next to 30 Degrees from *o* towards *g* in the Semi-circle, and ſo Marking where it Cuts the *Contingent-line*, as before: Or elſe by transferring the diſtance of the ſame number of Hour-Lines from the 6 a Clock-line already drawn on the ſide *e h*, to the ſide *e g*, as in Prob. 2. of this Book is more fully ſhewed.

Having thus Marked out on the *Contingent-line* the diſtances of each Hour, I draw a Line parallel to the *Contingent-line*, and draw Lines from every Hour Markt on the *Contingent* to croſs the *Contingent-line* at Right Angles, and continue each Line to the Line parallel to the *Contingent*; and theſe Lines ſhall be the Hour Lines of an *Eaſt Plain.* To theſe Hour Lines I ſet Figures, as in the *Scheme* may be ſeen.

The *Style* DK of this *Dyal* (as well as of others) muſt ſtand parallel to the Axis of the *World*: It muſt be alſo parallel to all the Hour Lines, and ſtand directly over the 6 a Clock Line, and that ſo high as in the diſtance between the Center of the Semi-*Circle of Poſition* and the point where the 6 a Clock Line Cuts the *Contingent-line*: Or (which is all one) at ſuch an Height as when it is laid Flat down upon the *Plain* it may juſt reach the 9 a Clock Line.

PROB. VII.

To make an Erect Direct Weſt Dyal.

AN *Erect Direct Weſt Dyal* is the ſame in all reſpects with an *Erect Direct Eaſt Dyal*; only as the *Eaſt* ſhews the Fore-noon Hours, the *Weſt* ſhews the Afternoon-Hours.

Thus if you ſhould draw the *Eaſt Dyal* on any tranſparent *Plain*, as on Glaſs, Horn, or an oyled Paper, on the one Side will appear an *Eaſt Dyal*, and on the other a *Weſt*; only the Figures (as was ſaid before) muſt be changed; for that which in the *Eaſt Dyal* is 11, in the *Weſt* muſt be 1: that which in the *Eaſt Dyal* is 10, in the *Weſt* muſt be 2: that which in the *Eaſt Dyal* is 9, in the *Weſt* muſt be three: &c.

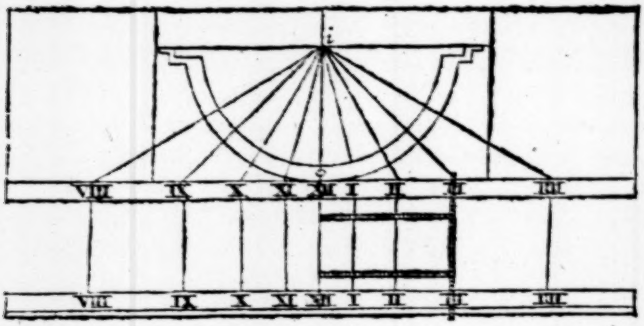
PROB. VIII.

To mark a Polar Dyal.

POlar *Dyals* are *Horizontal Dyals* under the *Equinoctial*: They are of the ſame kind with *Eaſt* and *Weſt Dyals*; Only whereas *Eaſt* and *Weſt Dyals* have but the Hour Lines of Half the Longeſt Day deſcribed on them, theſe have all the Hour

Lines of the whole Day; and are marked on both ſides the Noon Line; as in the following Figure.

The *Style* of this *Dyal* muſt ſtand over the Noon Line, Parallel to the Plain; for then it will alſo be Parallel to the *Axis*



of the *World*: And its Highth above the *Plain* muſt be the diſtance between the Center of the Semi-Circle and the point in the *Contingent-Line* Cut by the Noon-Line. But I have inſerted the Figure, which alone is ſufficient inſtructions.

PROB. IX.

To make Erect South Dyals, Declining Eaſtwards *or* Weſtwards.

DRaw on your *Plain* an *Horizontal-line*, and on it deſcribe a Semi-circle, as you were taught in Prob. 4.

Then Rectifie the *Globe*, *Quadrant of Altitude*, *Colure*, and *Hour-Index*, as by the ſame Probleme: And bring the lower end of the *Quadrant of Altitude* to the Deg. of Declination from the *North* point in the *Horizon Eaſtwards* or *Weſtwards*; for then the *Quadrant of Altitude* ſhall repreſent a *Plain Declining* from the *North Eaſtwards*, or *Weſtwards* accordingly. Then turn the *Globe Eaſtwards*, till the *Index* of the *Hour-circle* points to all the Hours before Noon, and examine in what number of Degrees from the *Zenith* the *Colure* Cuts the *Quadrant of Altitude*, when the *Index* points to each Hour, for a Line drawn from the Center A through the ſame number of Degrees reckoned from the Perpendicular A B, which is the 12 a Clock Line towards C on the *Plain*, ſhall be the ſame Hour Lines the Index points at.

Example.

I would make an *Erect Dyal Declining* from the *North* towards the *Eaſt* 63 Degrees: The *Globe*, *Quadrant of Altitude*, *Vernal Colure*, and *Hour Index* Rectified, as before I bring the lower end of the *Quadrant of Altitude* to 63 Degrees counted from the *North* Point of the *Horizon* towards the *Eaſt*: Then

I turn the *Globe Eaſtwards* till the *Index* points to	11	a Clock: or till 15 Degrees of the *Equator* paſs through the *Meridian*, and find the *Colure* Cut the *Quadrant of Altitude* in	9.43	counted from the *Zenith*.
	10		19. 0	
	9		25.57	
	8		35.10	
	7		45.56	
	6		60.15	
	5		79.45	

And theſe are the diſtances of the Fore-noon Hour-lines which I ſeek in the *Weſt*-ſide of the *Plain*, *viz.* from B towards C; and through theſe diſtances I draw Lines from the Center, and theſe Lines ſhall be the Fore-noon Hour-lines.

Now herein is a difference between *Declining Dyals*, and *Direct Dyals*; For having found the diſtances of the Hour-lines for one Half of the Day, be it either for Before-noon, or After-noon in a *Direct Dyal*, you have alſo found the diſtances for the other Half Day; becauſe, as was ſaid, Prob. 3. Equal number of Hours have equal diſtance from the Noon-line: But in *Declining Dyals* it is not ſo; becauſe the *Sun* remaining longer upon that ſide of the *Plain* which it *Declines* to, than it doth upon the contrary Side, there will be a greater number of Hour-lines upon it, and by conſequence the diſtance of the Hour-lines leſs than on the contrary Side of the *Plain*.

Therefore for finding the After-noon Hour-lines, I turn about the *Quadrant of Altitude* upon the *Zenith* Point, till the lower end of it come to the Degree of the *Horizon* oppoſite to that Deg. of *Declination* that the *Quadrant of Altitude* was placed at when I ſought the Fore-noon Hour-Lines, *viz.* to 63 Degrees counted from the *South* toward the *Weſt*, and bring the *Vernal Colure* again to the *Meridian*, and the *Index* (as before) to 12. Then,

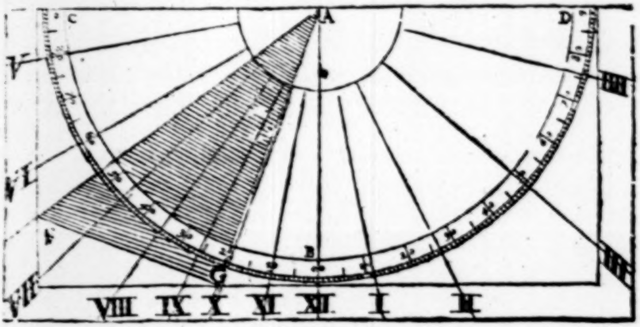
turning the *Globe* *Westward* till the *Index* points to	1	a Clock, or till 15 Deg. of the *Equa.* paſs through the *Meri.* I find the *Colure* Cut the *Quadrant* of *Altitude* in	11.20	counted from the *Zenith.*
	2		26.47	
	3		49.20	
	4		75.52	

And theſe are the diſtances of the After Noon Hour Lines, which diſtances I ſeek in the *Eaſt* Side of the *Plain*, viz. from B towards D (as before) and ſo drawing Lines from the Center A through theſe diſtances, I have all the Afternoon Hour Lines alſo drawn on my *Plain*.

You may note, that this *Plain* is capable to receive no more Hour Lines After Noon than 4; for when the *Colure* goes off the *Quadrant of Altitude*, the Sun goes off theſe kind of *Plains*.

To theſe Hour Lines I ſet their Numbers, as you may ſee in the *Figure*.

Then to find both the diſtances of the *Subſtyler* line from the 12 a Clock line, and the Elevation of the *Style* above the *Plain*, Bring the *Colure* to the number of Degrees of the *Plains Declination*, counted in the *Horizon* from the *South* Point to the *Eaſt* Point, and the *Quadrant of Altitude* to the Degrees of the *Plains Declination*, counted in the *Horizon* from the *North* Point towards the *Eaſt*, ſo ſhall the *Quadrant of Altitude* and the *Colure* Cut each other at Right Angles; and the number of Deg. comprehended between the *Colure* and the *Zenith* in the *Quadrant of Altitude*, ſhall be the number of Degrees between the *Subſtyler* Line and the 12 a Clock Line, which in this *Example* is 19 Degrees 45 Min. and the number of Degrees comprehended between the *Quadrant of Altitude* and the *Pole*, counted in the *Colure*, ſhall be the number of Degrees that the *Style* is to be Elevated above the *Plain*, which in this *Example* is 33 Degrees, 40 Min. Wherefore, for the diſtance of the *Subſtyler* Line from the 12 a Clock Line, I count in the Circle from the 12 a Clock Line in the contrary ſide of the *Plain*, *viz.* in the *Weſt* ſide, becauſe the *Plain Declines* towards the *Eaſt*) 19 Deg. 45 Min. as at D, and through that number of Degrees and Min. from the Center A, I draw the Line A G, which ſhall be the *Subſtyler* Line: And from the *Subſtyler* Line (either way) I number 33 Degrees 40 Min. the Elevation of the *Style* above the *Plain*, and through theſe Degrees and Minutes I draw from the Center A, the Line A F, for the *Style* or *Gnomen*; Then I let fall the Perpendicular F G upon the *Subſtyle* A G: So is there a Triangle



made, which if it be erected Perpendicular upon the *Subſtyle* A G, the *Style* A F ſhall be Parallel to the *Axis* of the *World*, and caſt a Shadow upon the Hour of the Day.

Here you may ſee that in *Declining Dyals* the *Style* doth not ſtand at the ſame Elevation above the *Plain*, that it doth in *Erect Direct Dyals*; neither doth it ſtand over the 12 a Clock Line, but ſwerves from it towards the Quarter of *Declination*.

PROB. X.

To make a South Erect Dyal, Declining Eaſtwards *or* Weſtwards.

As in Prob. 5. an *Erect Direct North Dyal* hath the ſame Declination that an *Erect Direct South Dyal* hath, and differs only in the placing the *Figures* of the Hour Lines: So a *South Erect Dyal* that *Declines Eaſtwards*, or *Weſtwards*, differs from a *North Erect Dyal* that *Declines Eaſtwards*, or *Weſtwards*, the ſame number of Degrees, only in placing the Hour Lines at the ſame diſtance on the contrary Side of the *Plain*, and by tranſpoſing the *Figures* of 11 for 1: 10 for 2: 9 for 3, &c.

Thus, if you draw upon Glaſs, Horn, or an Oiled Paper, the *North Dyal Declining Eaſtwards*, as in the foregoing Probleme, and place it to its due Situation, the Back Side of it ſhall be a *South Dyal Declining* towards the *Weſt* ſo many Degrees as the aforeſaid *Declines* towards the *Eaſt*; and the only difference in it will be the *Figures* of the Hour Lines; as was ſaid before.

PROB. XI.

To make Direct Reclining *or* Inclining Dyals.

D*irect Reclining* or *Inclining Dyals* are the ſame with *Erect Direct Dyals* that are made for the *Latitude* of ſome other Places: The *Latitude* of which Places are either More than the *Latitude* of your Place if the *Plain Recline*, or leſs if the *Plain Incline*; and that in ſuch a Proportion as the Arch of *Reclination* or *Inclination* of your *Plain* is.

Thus a *Direct South Dyal Reclining* 10 Degrees in *Londons Latitude*, *viz.* 51½ Degrees, is an *Erect Direct Dyal* made for the *Latitude* of 61½ Degrees: And a *Direct South Dyal Inclining* 10 Degrees in the *Latitude* 51½ Degrees, is an *Erect Direct Dyal* in the *Latitude* 41½ Degrees; and is to be made according to the Directions in Prob. 4.

PROB. XII.

To make Declining Reclining, *or* Declining Inclining Dyals.

THE diſtances of the Hour Lines either for a *Declining Reclining Plain*, or a *Declining Inclining Plain*, may moſt eaſily be found upon the *Plain* of the *Horizon*. That is, (as ſome Authors call it,) by the *Horizontal Dyal*, by changing the Circles of the *Globe* one into another: So as the *Plain* of the *Horizon* may ſerve to repreſent the *Dyal Plain*; Yet this way not being Natural, becauſe you muſt admit one Circle to be another, and that in Young Learners might ſometimes breed a little difficulty, *Gemma Friſius*, *Metius* and *Bleau* have preſcribed a thin Braſs Plate to be made, equal to a *Semi-Circle* of the *Equinoctial*, and divided from the Middle Point of it either way into 90 Degrees, which may not unproperly be called a *Gnomenical Semi-Circle*. This Semi-Circle muſt be bowed cloſe to the Body of the *Globe* into a Semi-Circular Form, and ſo ſet to any *Reclination* or *Inclination*, and then it will repreſent a *Reclining* or *Inclining Plain* : And by the motion of the *Colure* through the ſeveral Degrees of this Semi-Circle the diſtances of the Hour lines may be found : Thus,

The *Globe Quadrant of Alitude*, *Colure*, and *Hour Index* Rectified ; as by Prob. 4. Bring the lower end of the *Quadrant* of *Altitude* to the degree in the *Horizon* of the *plains Declination*, if your *Plain* be a *South Declining Incliner*, or a *North Declining Recliner*, and count on the *Quadrant of Altitude* from the *Zenith* downwards the number of Degrees of *Reclinatin*, or *Inclination*, and to that number of Deg. bring the middle of the *Gnomonical Semi-circle*, and let the ends of it Cut the *Horizon* on either ſide in the Degrees of the *Plains Azimuth*, ſo ſhall the *Gnomonical-Semicircle* repreſent your *Reclining* or *Inclining Plain*. And ſo oft as 15 Degrees of the *Equator* paſſes through the *Meridian*, ſo oft ſhall you enquier what Deg. of the *Gnomonical ſemi-Circle* the *Colure* Cuts; for ſo many Degrees aſunder muſt the ſeveral reſpective Hour Lines of a *Reclining Declining Plain* be in a Semi-Circle divided into 180 Degrees.

But if your *Plain* be a *South Declining Recliner*, or a *North Decliner Incliner*; Bring the *Quadrant of Altitude* to the Deg. of the *Horizon* oppoſite to the Degree of the *Plains Declination* (becauſe the Upper ſide of the *Plain* lies beyond the *Zenith*) counted from the *South* Point in the *South Recliner*: and from the *North* point in *North Incliners*.

Then find the *Height* of the *Style*, and place of the *Subſtile* : thus, keep your *Gnomonical Semi Circle* in its Poſition : But turn the *Quadrant of Altitude* about on the *Zenith* point till the Lower end of it comes to the Deg. of the *Horizon* oppoſite to the Deg. it was placed at before, and turn about the Globe till the *Colure* Cut the *Quadrant of Altitude* above the *Horizon* in the number of Degrees the *Plain Reclines* from the *Zenith*; ſo ſhall the *Colure* Cut the *Gnomonical Semi-Circle* at Right Angles; then count the Degrees contianed between the middle of the *Gnomonical Semi-Circle* and the *Colure*, for that number of Deg. is the diſtance of the *Subſtile* from a Perpendicular Line in the middle of your *Plain*, and muſt be placed *Weſtwards* of the ſaid Perpendicular, if your *Plain decline* from the *South Eaſtwards*; or *Eaſtwards*, if your *Plain Decline* from the *South Weſt-*

wards. Then Obſerve how many Degrees are contained betwen the Semi-Circle and the *Pole*; for that number of Degrees is the number of Degrees that the *Style* is to be Elevated above the *Subſtyle*.

Example.

Here at *London*, I would make a *Dyal* upon a *Plain Declining* from the *South Eaſtwards* 30 Degrees, and *Reclining* from the *Zenith* 20 Degrees; *Londons Latitude* is 51½ Degrees: Therefore, having on the *Plain* deſcribed a Semi-Circle, *&c.* as was directed *Prob* 4. I Rectifie the *Globe*, *Quadrant of Altitude*, *Colure* and *Hour Index*, as by the ſame probleme, and bring the lower end of the *Quadrant of Altitude* to 30 Degrees from the *North* Point of the *Horizon* towards the *VVeſt*, becauſe that is the Deg. oppoſite to the Degree of the *Plains Declination, viz.* to 30 Degrees from the *South Eaſtwards*, and I bring the middle of the *Gnomonical Semi-Circle* to 20 Degrees of the *Quadrant of altitude* counted from the *Zenith* downwards towards the *Horizon*, and the ends of the *Gnomonical Semi-Circle*, to the Degrees of *Azimuth* the *Plain* lies in the *Horizon*, *viz.* to 30 Degrees from the *Eaſt* Point *Northwards*, and to 30 Degrees from the *Weſt* Point *Southwards*, ſo ſhall 11 Degrees 10 Minutes of the *Gnomonical Semi-Circle* be comprehended betwen the *Quadrant of Altitude* and the *Braſen Meridian:* Theſe 11 Degrees 10 Minutes ſhew that the 12 a Clock Line is diſtant from the Perpendicular A B 11 Degrees 10 Minutes: Then to find all the Fore-Noon Hour Lines,

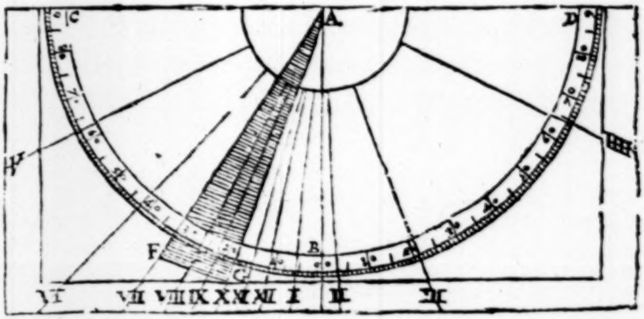
I turn the *Globe Eaſtwards* till the *Index* points to	11	a Clock; or till 15 Deg. of the *Equater* paſs through the *Meridian*; and find the *Colure* cut the *Gnomonical Semi-Circle* in	15. 8	counted from the midle of the *Gnomonical Semi-Circle*.
	10		18.56	
	9		22.37	
	8		26.52	
	7		32.37	
	6		42. 5	
	5		62.43	

And theſe are the diſtances of the Fore-Noon Hour lines; to which diſtances you may ſet pricks on the *VVeſt* ſide the *Semi-Circle* of the *Plain*, *viz.* from B to C.

The After Noon Hour Lines are found by bringing the *Colure* again to the *Meridian*, and the *Index* of the *Hour Circle* to 12. For, then,

turning the *Globe* *Weſtwards* till the *Index* points to	1	a Clock, or till 15 Deg. of the *Equator* paſs through the *Merid.* I find the *Colure* Cut the *Gnomon. Semi-Cir.*	5.45	counted from the middle of the *Gnomon.* *Semi-Circle.*
	2		2.54	
	3		20.52	
	4		64;36	

And theſe are the diſtances of the After Noon Hour Lines; and muſt all but the 1 a Clock Hour Line be prick'd down at their reſpective diſtances, on the Eaſt ſide the *Plain*, *viz.* from B to D: But becauſe the *Colure* comes not to the middle of the *Gnomonical Semi-Circle* before the firſt 15 Degrees of the *Equator* paſs through the *Meridian* after 12. Therefore the 1 a Clock muſt ſtand 5 Degrees 45 Minutes on the *Weſt* ſide of the *Plain:* And for this Cauſe I made diſtinction with a Line between the 1 a Clock, and the 2 a Clock, in the foregoing Table. Then I draw Lines from the Center A, through every one of theſe Pricks in the Semi-Circle, and they ſhall be the Hour Lines of this *Declining Reclining Plain.*



Having drawn the Hour Lines, I remove the *Quadrant of Altitude* to the Degree of the *Horizon*, oppoſite to the Deg. it was at before, *viz.* to 30 Degrees from the *South Eaſtwards*, which is ſo much as the *Plain Declines Eaſtwards*; But I let the *Gnomonical Semi-Circle* ſtand as it did: And turning about the *Globe*

Globe till the *Colure* Cut the *Quadrant of Altitude* in 20 Degrees, Counted from the *Horizon* Upwards; *viz.* the Degrees of *Reclination*, I find 18 Degrees 40 Min. contained between the middle of the *Gnomonical Semi-Circle* and the *Brazen Meridian*, which is the diſtance of the *Subſtyle* from the Perpendicular; And I find the *Gnomonical Semi-Circle* Cut the *Colure* in 13 Degrees 49 Minutes from the *Pole*, which is the Heighth that the *Style* muſt be raiſed over the *Subſtyle*; Therefore I Prick off in the Semi-Circle on the *Plain*, the diſtance of the *Subſtyle* 18 Degrees 40 Minutes from the Perpendicular *Weſtward*, becauſe this *Plain Declines Eaſtwards*: And from the Center A, I draw through that Prick the Line A E, which ſhall be the *Subſtyle*, and from this *Subſtyle* (either way) I count in the Semi-Circle on the *Plain* 13 Degrees 49 Minutes, and there make a Prick: Then from the Center A, I draw through that Prick the Line A F, to repreſent the *Style* or *Gnomon*: Then I let fall the Perpendicular F G upon the *Subſtyle* A G; ſo is a Triangle made, which if it be erected Perpendicularly upon the *Subſtyle* A G, the *Style* A F ſhall be Parallel to the *Axis* of the *World*, and caſt a Shadow upon the Hour of the Day.

Having made this *Dyal*, you have made four ſeveral *Dyals*; whereof this is one; And his Oppoſite, *viz. North Declining Weſtwards* 30 Degrees *Inclining* to the *Horizon* 70 Degrees is another: The *South Declining Weſtwards* 30 Degrees *Reclining* from the *Zenith* 20 Degrees is another: And his Oppoſite, *viz. North Declining Eaſtwards* 30 Degrees inclining to the *Horizon* 70 Degrees is the other.

PROB. XIII.

To make a Dyal *upon a* Declining Inclining Plain.

THE Precepts for making theſe *Dyals* are delivered in the foregoing Problme: Therefore we ſhall at firſt come to an Example.

I would make a *Dyal* upon a *Plain* in *Londons Latitude*, *Declining* from the *South Weſtwards* 25 Degrees, and *Inclining* towards the *Horizon* by the ſpace of an Arch containing 14 Degrees. Having firſt deſcribed on the *Plain* a Semi-Circle, as was directed, Prob. 4. I Rectifie the *Globe*, *Quadrant of*

Altitude, *Colure*, and *Hour-Index*, as by the ſame Probleme, and bring the lower end of the *Quadrant of Altitude* to the Degree of the *Plains Declination*, *viz.* to 25 Degrees counted from the *South Weſtwards*, and the ends of the *Gnomonical Semicircle*, to the Degrees of *Azimuth*, between which the *Plain* lies, *viz.* to 25 Degrees from the *Weſt Northwards*, and 25 Degrees from the *Eaſt Southwards*; and the middle of the *Gnomonical Semi-circle* to the Degree of the *Plains Inclination*, *viz.* 14 Degrees counted from the *Zenith* downwards on the *Quadrant of Altitude*: Then counting the Degrees of the *Gnomonical Semi-Circle* contained between the middle of the ſame and the *Brazen Meridian*, I find 5 Degrees 30 Minutes; Therefore I number in the Semi-Circle deſcribed on the *Plain* from the Perpendicular *Weſtwards*, 5 Degrees 30 Minutes, *viz.* from B to C, and there place the 12 a Clock-line. For finding all the Fore-Noon Hour diſtances

I turn the *Globe Eaſtwards* till the *Index* points to	11	a Clock, or till 15 Deg. of the *Equa.* paſs through the *Meridian* and find the Colure Cut the *Gnomon Semi-Circle* in	20. 5	counted from the middle of the *Gnomon Semi-circle.*
	10		36. 7	
	9		56.24	
	8		76.31	

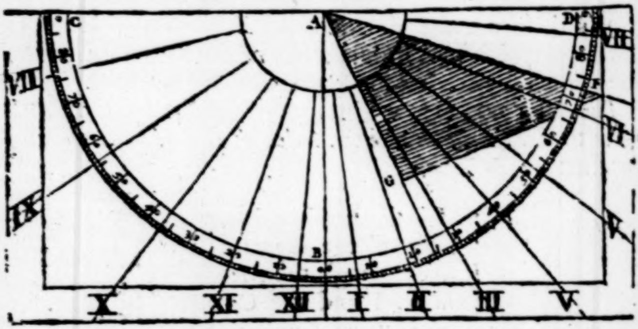
And theſe are the diſtances of all the Fore-Noon Hour Lines, to which ſeveral diſtances I made Pricks on the *Weſt* ſide the Semi-circle on the Plain, *viz.* from B to C.

The After-noon Hour Lines are found bringing the *Colure* again to the *Meridian* and the *Index* of the *Hour-circle* to 12. For then

turning the *Globe Weſtwards* till the *Index* points to	1	a Clock, or till 15 Degrees of the *Equator* paſs through the *Meridian*, I find the *Colure* Cut the *Gnomonical Semi-circle* in	6.20	counted from the middle of the *Gnomonical Semi-Circle.*
	2		18. 2	
	3		28.45	
	4		39.56	
	5		52.30	
	6		67.19	
	7		84.63	

And theſe are the diſtances of the After-noon Hour Lines which I alſo Prick down at their reſpective diſtances from the Perpendicular *Eaſtwards*, *viz.* from B towards D on the *Plain*, and by drawing Lines from the Center A through all the Pricks, I have all the Hour Lines that this *Plain* will admit of.

Having drawn the Hour Lines, I remove the lower end of the *Quadrant of Altitude* to the Deg. of the *Horizon* oppoſite to the Degree it was at before, *viz.* to 25 Degrees from the *North Eaſtwards*, which is ſo much as the *Declination* is *Weſtward*; but I let the *Gnomonical Semi-Circle* ſtand as it did, and turn about the *Globe* till the *Colure* Cuts the *Quadrant of Altitude* in 14 Degrees counted from the *Horizon* upwards, which is the *Inclination* of the *Plain*: Then I find 24 Degrees 3 Minutes comprehended between the middle of the *Gnomonical Semi-Circle* and the *Braſen Meridian*, which is the diſtance of the *Subſtyle* from the Perpendicular; and this diſtance I count *Weſtwards* on the *Plain*, becauſe the middle of the Semi-Circle lies *VVeſtwards* on the *Globe*, and draw the Line AG through it for the *Subſtyle*. And I find the *Gnomonical Semi-Circle* Cut the *Colure* in 48 Degrees 5 Minutes for the Height that the *Style* muſt be Elevated over the *Subſtyle*. Therefore I make a Prick on the *Plain* 48 Degrees, 5 Minutes diſtant from the *Subſtyle*, and through that Prick I draw the Line AF to repreſent the *ſtyle* or *Gnomin*, Then I let fall the Perpendicular F G upon the *Subſtyle* A G, ſo is there a Triangle made; which if it be Erected



Perpendicularly upon the *Subſtyle* A G the *Style* A F ſhall be parallel to the *Axis* of the *World*, and caſt a Shadow upon the Hour of the Day.

Having made this *Dyal* you have alſo four *Dyals* made; as well as in the former Probleme: For this is one; and it's oppoſite, *viz.* *North Declining Eaſtwards* 25 Degrees, *Reclining* 76 Degrees is another; The *South Declining Eaſtwards* 25 Degrees

Incliner 14 Degrees is another, and its oppoſite, viz. *North Declining Weſtwards* 25 Degrees *Declining* 76 Degrees is another.

PROB. XIV.

To find in what Place of the Earth, *any manner of* Plain *that in your* Habitation *is not* Horizontal, *ſhall be* Horizontal.

IT was ſaid in the *Preface* that all manner of *Plains* however Situate, are parellel to ſome Country or other on the *Earth*: Therefore all manner of *Plains* are indeed *Horizontal Plains* and the diſtances of the Hour Lines to be deſcribed on them may be found as the diſtances of the Hour Lines of the *Horizontal* Dyal in Prob. 3. It reſts now to learn in what Place of the *Earth* any *Plain* that is not *Horizontal* in your Habitation ſhall become *Horizontal*: And for help of your Underſtanding herein, Take theſe following Rules.

1. If your Plain be Erect Direct North, or South, it ſhall be an *Horizontal* in the ſame Longitude at 90 Degrees diſtance on the Meridian (counted from the *Zenith* of your Place) through the *Equinoctial*. See an *Example* of this in Prob 4. where I have reduced an Erect Direct Dyal, to an *Horizontal*. Thus an *Erect Plain* under the *Pole* is an *Horizontal* under the *Equator*; and an Erect Direct in 80 Degrees *North Latitude* is in the ſame *Longitude* an *Horizontal* at 10 Degrees *South Latitude*. An Erect Direct in 70 Degrees *North Latitude*, is in the ſame *Longitude*, an *Horizontal* at 20 Degrees *South Latitude*: and ſo to any other Degrees of *Latitude* (as aforeſaid) till you come to 45 Degrees *Latitude*, where an *Erect* is an *Horizontal*, and an *Horizontal* an *Erect*: Only as the Hour Lines of the *Horizontal* being turned Downwards) are numbred from the Right Hand towards the Left in the Erect Direct Dyal they are numbred from the the Left Hand towards the Righ.

2. If your *Plaon* be Erect Declining, it ſhall be an *Horizontal Plain* at that point on the *Globe* which is againſt the Degree of Declination, fouud in the *Horizon*.

But note, If your *Plain* Declines Weſtwards, the *Sun* comes ſooner to the *Meridian* of it, than to the *Meridian* of the Place where it becomes an *Horizontal Plain*, and that by ſo many Hours or Minutes as the Degrees of the difference of *Longitude* between the two Places converted into *Time* amounts to, If it *Declines Eaſtward*, the *Sun* comes ſo much later to the Meridian of it: Add for this Cauſe (though the making this *Dyal* be the ſame with an *Horizontal Dyal* for another place, yet in Reſpect of *Time*) there will be a difference betwen them.

Example.

I would make the *North Dyal Declining Eaſt* 63 Degrees, as in Prob 9. by the *Plain* of the *Horizon*: Firſt I ſeek in what Place of the *Earth* it ſhall become an *Horizontal Plain*: Thus, I Elevate the *Pole* of the *Globe* 51 ½ Degrees above the *Horizon*, and bring the *Vernal Colure* to the *Meridian*; then I count from the *South* Point in the *Horizon Eaſtwards* 27 Degrees, and on the Point on the *Globe* directly againſt thoſe 27 Degrees I make a Prick for the place where a *Plain* that *Declines* 63 Degrees from the *North Eaſtwards* at *London* ſhall be *Horizontal*; or which is all one, this *Declining Plain* at *London* ſhall ly in the *Horizon* of that Prick: This Prick for diſtinction ſake we ſhall hereafter call the *Horizontal Place*: Then by Prob. 1 of the Second Book, I examine the *Latitude* and *Longitude* of this *Horizontal Place*, and find *Latitude* 33 40 *South*; and *Longitude* from the *Colure* 33 Degrees, which is the difference of *Longitude* between *London* and the *Horizontal Place*: which being converted into *Time*, by allowing for every 15. Degrees 1. Hour of *Time*, gives 2 Hours 12 Minutes that the *Sun* comes ſooner to the *Meridian* of the *Horizontal Place*, than to the *Meridian* of the *Plain* at *London*; ſo that when it is 12 a Clock There, it will be but 9 a Clock 48. Minutes Here; when 12. a Clock Here, it will be 2. a Clock 12. Minutes There, &c.

Having thus found in what *Longitude* from *London* and *Latitude* this *Plain* is Parallel to the *Horizon*, I ſeek the diſtance of the Hour-lines upon the *Plain* of the *Horizon*. Thus, I Elevate the *Pole* of the *Globe* to the Height of the *Pole* in the *Horizontal Place*, viz. 33 Degrees 40 Minutes, and bring the *Horizontal Place* on the *Globe* to the *Meridian*, and the *Index* of the *Hour Circle* to 12. Then I examine the Degree of the *Horizon* the *Colure* Cuts, and find it 19½ from the *South Weſtwards*, This 19 ½

Degrees repreſents the *Meridian* Line of the *Horizontal Place:* And alſo the *Subſtylar* Line here at *London*; Therefore this $19\frac{1}{4}$. Degrees I count from the Perpendicular A B of the Plain, and from the Center A draw the Line A G through them; Becauſe from this Line on the *Plain* all the Hour Lines muſt be numbred, and not (as all along hitherto) from the Perpendicular of the *Plain*. Then

	11	a Clock; or till 15	10. 2	
turning the	10	Deg. of the *Equa-*	0.45	
Globe Eaſt-	9	*tor* paſs through	6.12	counted from
wards till	8	the *Meridian*; I	15.25	the *Meridian*.
the *Index*	7	find the *Colure*	26.11	
points to	6	Cut the *Horizon*	40.30	
	5	in	60. 0	

And theſe are the diſtances of the Foor-noon Hour Lines; which diſtances I transfer by Pricks to the *Plain*. But as in Prob. 9. I ſought the diſtances from the Perpendicular on the *Plain*, ſo now in this Caſe (as was ſaid before) I ſeek them from the *Subſtyle*, and through theſe Pricks I draw Lines from the Center, as in other *Dyals*, and theſe Lines ſhall be the Fore-Noon Hour Lines.

To find the After-noon Hour diſtances, I bring the *Horizontal Places* on the *Globe* again to the *Meridian*, and the *Index* of the *Hour-Circle* to 12, and

turning the	1	a Clock, or till 15 Deg. of the	31. 5	counted
Globe Weſt-	2	*Equator* paſs through the *Me-*	46.32	from the
wards till the	3	*ridian*, I find the *Colure* Cut the	68. 5	*Meridian*.
Index points to	4	*Horizon in*	95.37	

And theſe are diſtances of all the After-noon Hour Lines; which I alſo transfer to the *Plain*, counting them from the *Subſtyle*, and draw Lines from the Center A through the diſtances; and theſe Lines ſhall be the After-noon Hour Lines.

Then from the *Subſtyle* I count the Degrees and Minutes of the *Latitude* of the *Horizontal Place*, viz. 33 Degrees, and through theſe Degrees and Minutes I draw the Line AF from the Center A for the *Style:* Then from the *Style* I let fall the Perpendicular FG upon the *Subſtyle*, ſo is there a Triangle made which if it be erected perpendicularly upon the *Subſtile* A G, the *Style* AF ſhall be parellel to the *Axis* of the *World*, and caſt a ſhadow upon the Hour of the Day.

3. If your *Plain* be a *Direct Recliner* Seek in the *Longitude* of your Place the Complement to 90 of your *Plains Reclination*. For there a *direct Recliner* becomes an *Horizontal Plain*.

4. If your *Plain* be a *Declining Recliner*. The *Globe* and *Quadrant of Altitude* Rectified, Bring your Habitation on the *Terreſtrial Globe* to the *Meridian*, and the *Quadrants Altitude* to the *Declination*, as by the Second Rule in this Probleme; and count upwards on the *Quadrant of Altitude* the *Reclination*, and there make a prick on the *Globe* by the ſide of the *Quadrant of Altitude*, for at that prick on the *Globe* the *Declining Reciner* ſhall become an *Horizontal Plain*; then examine the Latitude of that Prick, as by prob. 1. of the 2d. Book, and the difference of Longitude, as by prob. 9. of the 3d Book, and convert the difference of Longitude into *Time*, by allowing for every 15 Degrees 1 hours *Time*, for every Degree 4 Minutes *Time*, and ſo proportionably, ſo ſhall you know what Hours and Minutes the *Sun* comes ſooner or later to the Meredian of your Habitation than to the Meridian of that *Place* where it becomes an *Horizontal Plain*; Sooner, if the *Globe* were turned *Eaſtwards*; but Later if it where turned *Weſtwards*.

Having thus found out where this *Plain* becomes *Horizontal*, make your *Dyal* to this *Plain*, as by the ſecond Rule in this Probleme: Find alſo the *Style*, as is there directed.

5. If your *Plain* be a *Declining Incliner*, the *Globe* and *Quadrant of Altitude* Rectified, Bring the *Colure* to the *Meridian* and the *Quadrant of Altitude* to the Degree of the *Horizon*, oppoſite to the Degree of the *Plains Declination*, and count upwards on the *Quadrant of Altitude* the Degrees of *Inclination*, and make a Prick there; For in the *Antipodes* of that Prick (found as by Prob. 29 of the Second Book) that *Declining Incliner* ſhall become an *Horizontal Plain*. Then find the *Latitude* and difference of *Longitude* of this *Antipodes*, by the former Rule, and make a *Dyal* to that *Plain*, as by the ſecond Rule in this Probleme. Find alſo the *Style*, as therein directed.

PROB.

PROB. XV.

To make a Dyal *on the* Ceeling *of a* Room, *where the* Direct Beams *of the* Sun *never come.*

FInd ſome convenient place in the *Tranſum* of a Window to place a ſmall round piece of Looking-Glaſs,about the bigneſs of a Groat, or leſs, ſo as it may lie exactly *Horizontal:* The point in the middle of this *Glaſs* we will mark A, and for diſtinctions ſake (with Mr *Palmer*) call it *Nodus*. Through this *Nodus* you muſt draw a *Meridian* Line on the Floor, Thus: Hang a plumb-line in the Window exactly over *Nodus*, and the Shadow that the Plumb-line caſts on the Floor juſt at Noon will be a *Meridian*-line; Or you may find a *Meridian*-line otherwiſe, as by the *Preface*. Having drawn the *Miridian*-line on the Floor, find a *Miridian*-line on the Ceeling, thus: Hold a plumb-line to the Ceeling, over that end of the *Meridian*-line next the Window; If the Plumbet Hang not exactly on the *Meridian*-line on the Floor remove your hand on the Ceeling one way or other, as you ſee cauſe till it do hang quietly juſt over it, and at the point where the Plumb-line touches the Ceeling make a mark,as at B,that mark B ſhall be directly over the *Meridian*-line on the Floor: then remove your Plumb-line to the other end of the Meridian-line on the Floor, and find a point on the Ceeling directly over it, as you did the former Point, as at C, and through theſe two point B and C on the Ceeling ſtrain and ſtriks a Line Blackt with Small-Coal or any other Colour(as *Carpenters* do)and that Line BC on the Ceeling ſhall be a *Merid.* line as well as that on the Floor: Then examine the *Altitude* of the *Equinoctial* as by prob. 6. of the Second Book you did the *Merid. Altitude* of the *Sun*, and faſten a String juſt on the *Nodus*, and remove that String in the *Meridian*-line on the Ceeling till it have the ſame Elevation in a *Quadrant*, that the *Equinoctial* hath in your Habitation, and through the point where the String touches the *Meridian*-line in the Ceeling ſhall a Line be drawn at right Angels with the *Merid.* to repreſent, the *Equinoctial*Line. Thus in our *Latitude* the Elevation of the *Equator* being 38½ Degrees; I remove the String faſtned to the *Nodus* forwards or backwards in the *Meridian*-line of the

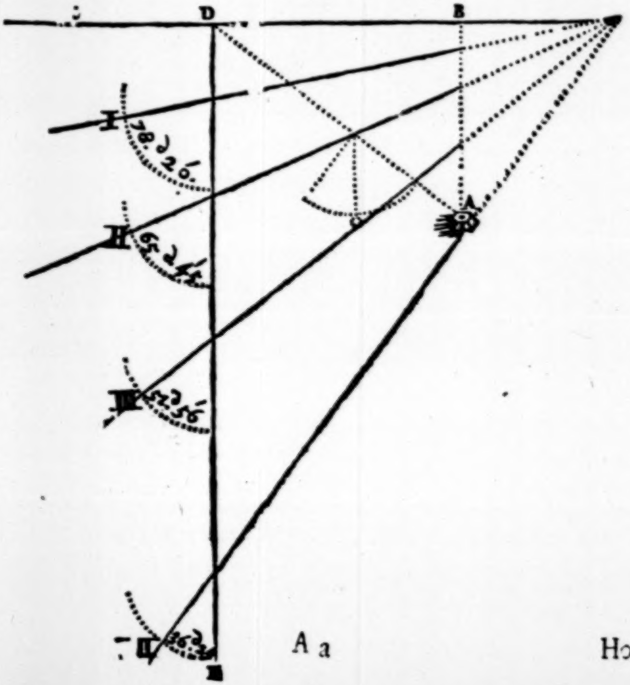
Ceeling, till the Plumb-line of a Quadrant when one of the ſides are applied to the String, falls upon 38½ Degrees, and then I find it touch the *Meridian* line at D in the Ceeling: therefore at D I make a mark, and through this mark ſtrike the Line DE (as before I did the *Merid.* Line) to Cut the *Meridiam*-line at Right Angles: This Line ſhall be the *Equinoctial*-Line.

Then I place the Center of the *Semi-Circle of poſition* upon *Nodus*, and under-prop it ſo, that the Flat ſide of it may ly Parellel to the String when it is ſtrained between the *Nodus* and the *Equinoctial*, and alſo ſo as the String may ly on the diviſion of the *Semi-Circle of poſition* marked 0, when it is held up to the *Meridian*-line in the Ceeling. Then removing the String the ſpace of 15 Deg. in the *Circle of Poſition* to the *Eaſtwards*, and extending it to the *Equa.* on the Ceeling, where the String touches the *Equa.* there ſhall be a point thro' which the 1 a Clock Hour-line ſhall be drawn: and Removing the String yet 15 Deg. further to the *Eaſtwards* in the *Semi-Circle Poſition*, and extending it alſo to the *Equater*, where it touches the *Equator*, there ſhall be a Point through which the 2 a Clock Hour-line ſhall be drawn. Removing the String yet 15 Degrees further to the *Eaſtwards* in the Semi-*Circle of Poſition*, and extending it to the *Equator*, there ſhall be a point through which the 3 a Clock Hour-line ſhall be drawn: The like for all the other After-noon Hour Lines; ſo oft as the String is removed through 15 Degrees on the Semi-*Circle of Poſition*, ſo oft ſhall it point out the After-Noon diſtances in the *Meridian*-line on the Ceeling.

The Situation of the Semi-*Circle of poſition* cannot conveniently be ſhewn in this Figure, unleſs it be drawn by the Rules of *Perſpective*; niether if it were, would it ſuit with the other Demonſtrations, except they were drawn by the ſame Rules alſo which to do would be hard for young Learners to underſtand: Therefore I have left out the Semi-*Circle of Poſition* in this *Figure*, and refer you for a Demonſtration thereof to the ſixth Problem; for even as the Lines drawn through every 15 Degrees of the Semi-*Circle of Poſition* there denote in a *Contingent*-line the diſtance of any Hour-line from the *Meridian*-line, even ſo a Line drawn through every 14 Degrees of the Semi-*Circle of Poſition* poſited (as aforeſaid) point out the *Equinoctial* line on the Ceeling the diſtance of each reſpective Hour-line from the *Meridian*-line.

Having thus found out the Points in the *Equator*, through which, the Afternoon Hour-lines are to be drawn, I may find the Forenoon Hour-diſtances alſo the ſame way, *viz.* by bringing the String to the ſeveral 15 Degrees on the Weſt Side the Semi-circle of *Poſition*, or elſe I need only meaſure the diſtances of each Hour-diſtance,found in the *Equator* from the *Meridian*-line on the Ceiling; for the ſame number of Hours from 12, have the ſame diſtance in the Equinoctial-line on the other ſide the *Meridian*, both before and after Noon: The 11 a Clock Hour-diſtance is the ſame from the *Meridian*-line,with the 1 a Clock diſtance on the other ſide the *Merid.* the 10 a Clock diſtance, the ſame with the 2 a Clock diſtance,the 9 with the 3,&c. And thus the diſtances of all the Hour-lines are found out on the *Equator*.

Now, if the Center of this Dial lay within Doors, you might draw Lines from the Center, thro' theſe Pricks, in the *Equator*, and thoſe Lines ſhould be the Hour-lines, as in other Dials: But the Center of this Dial lies without doors in the Air, and therefore not convenient for this purpoſe: So that for drawing the



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Hour-lines, you muſt conſider what Angle every Hour-line, in an *Horizontal Dial*, makes with the *Meridian*; that is, at what diſtance, in Degrees and Minutes, the Hour-lines of an *Horizontal Dial* cut the *Meridian*, which you may examine, as by *Prob.* 3. for an Angle, equal to the Complement of the ſame Angle, muſt each reſpective Hour-line with the *Equator* on the Ceiling have.

Thus upon the Point, mark'd for each Hour-diſtance in the *Equinoctial Line* on the Ceiling, I deſcribe the Arches I, II, III, IV, as in the Figure, and finding the diſtance from the *Meridian* of the Hour-lines of an *Horizontal Dial*, to be according to the third Probleme. Thus

The	1	a Clock Hour-line	11.40	whoſe Complement to 90, is	78.20
	2		24.15		65.45
	3		38.14		51.56
	4		53.36		36.24

I meaſure in a *Quadrant* of the ſame *Radius* with thoſe Arches, already drawn from the *Equinoctial* Line,

for the	1	a Clock Hour	78.20
	2		65.45
	3		51.56
	4		36.24

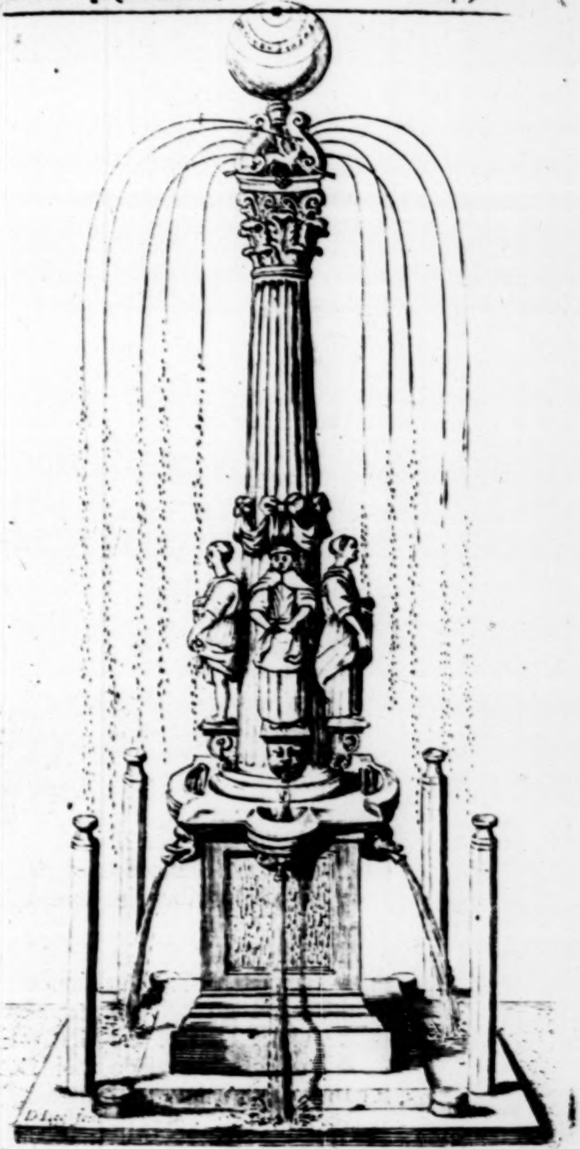
and transfer theſe diſtances to the Arches drawn on the Ceiling: For then ſtraight Lines, drawn through the mark, in the Arch, and through the mark, in the *Equator*, and prolonged both ways, to a convenient Length, ſhall be the ſeveral Hour-lines (aforeſaid;) And when the *Sun* ſhines upon the Glaſs at *Nodus*, its Beams ſhall reflect upon the Hour of the Day.

PROB. XVI.

To make a Dial *upon a ſolid* Ball *or* Globe, *that ſhall ſhew the Hour of the Day, without a* Gnomon.

THE *Equinoctial* of this *Globe*, or (which is all one) the middle Line, muſt be divided into 24 equal Parts, and marked with 1, 2, 3, 4, *&c.* to 12, and then beginning again with 1, 2, 3, *&c.* to 12. Then if you Elevate one of the Poles ſo many Deg. above an Horizontal Line, as the Pole of the World is Elevated above the *Horizon* in your Habitation, and place one of the 12 directly to behold the *North*, and the other to behold the *South*; when the *Sun* ſhines on it, the *Globe* will be divided into two Halfs; the one Enlightned with the *Sun-ſhine*, and the other ſhadowed: And where the Enlightned Half is parted from the Shadowed Half, there you ſhall find in the *Equinoctial* the Hour of the Day; and that on two places on the Ball, becauſe the *Equinoctial* is cut in two oppoſite Points by the Light of the *Sun*.

A Dial of this ſort was made by Mr. *John Leek*, and ſet up on a Compoſite Column at *Leaden-Hall* Corner in *London*, in the Majoralty of Sir *John Dethick*, Knight. The *Figure* whereof I have inſerted, becauſe it a pretty piece of Ingenuity, and may perhaps ſtand ſome Lover of Art in ſtead, either for Imitation, or Help of Invention.



PROB. XVII.

To make a Dial *upon a* Glaſs Globe, *whoſe* Axis *ſhall caſt a Shadow upon the Hour of the Day.*

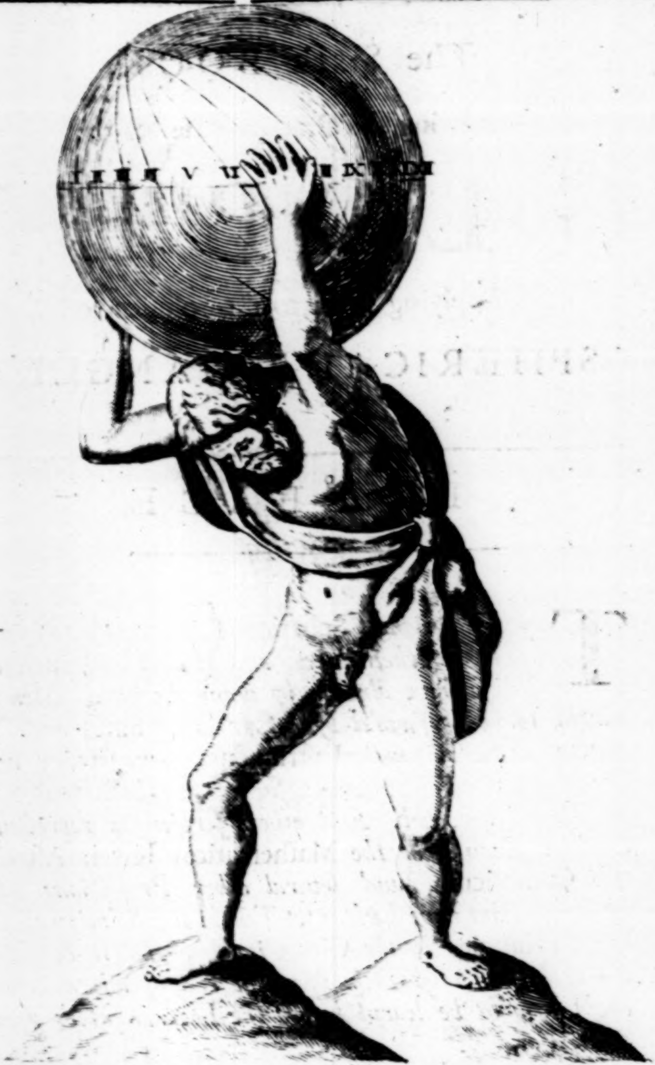
FIrſt divide the Equinoctial of your *Globe* into 24 equal Parts; and having a Semi-circle cut out of ſome Braſs Plate, or thin Wood, to the ſame Diameter your *Globe* is of, or a very little wider: Apply this Semi circle to the *Globe*, ſo as the upper edge of each end of the Semi circle may touch the Poles of the *Globe*, and the middle of the Semi-circle may at the ſame edge cut through ſome diviſion made in the Equinoctial: For then a Line drawn by the Edge of the Semi circle, thus poſited, ſhall be a *Meridian*-line: The ſame way you muſt draw *Meridian*-lines thro' every diviſion of the Equinoctial, and ſet Figures to them, beginning with 1,2,3,4, *&c.* to 12, and then beginning again with 1,2,3,4, *&c.* to 12 again. This *Globe* being made of Glaſs, and having an *Axis* of Wyre paſſing thro' it from Pole to Pole, will be an *Horizontal Dial* all the World over, if its *Axis* be ſet parallel to the *Axis* of the World in the ſame place; and one of the *Meridian*, marked 12, be ſet ſo, as it may directly behold the North point in Heaven, and the other the *South* point in Heaven, for then the *Axis* of the Globe ſhall caſt a Shadow upon the Hour of the Day.

And if you divide the upper Half of the *Glaſs Globe* from the under half, when the *Axis* ſtands parallel to the *Axis* of the World, by a Circle drawn round about the *Globe*, that Circle ſhall repreſent the *Horizon*, and the *Meridian*-lines, drawn on the *Globe*, ſhall be the Hour-lines, and have in the Horizontal Circle the ſame diſtance from the 12 a Clock Line, that the ſame Reſpective Hour-line was found to have, as by *Prob.* 3. of this Book.

But becauſe the Shadow of this *Axis* will not be diſcerned thro' the Glaſs Body, therefore you may with Water and White Lead ground together, lay a Ground on the Inſide of the under Half of the Glaſs to the Horizontal Circle, (as Looking-Glaſs-makers do their Looking-Glaſſes with *Tinfoil*) for then the Shadow will appear.

Such a Glaſs Globe-Dial had *Robert Titchborn*, once Lord-Mayor of *London*, ſtanding in his Garden, ſupported by *Atlas*.

The End of the Fifth Book.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IX

The Sixth BOOK.

Shewing the Practical Uſe of the
GLOBES.
Applying them to the Solution of
SPHERICAL TRIANGLES.

PRÆFACE.

THE *Solution of* Spherical Triangles, *is to know the Length of their* Sides, *and Width of their* Angles. *Theſe have already by many Learned Men been Taught to be perform'd by a* Canon *of* Sines *and* Tangents; *and alſo by many* Inſtruments, *ſome ſerving as Tables of* Sines *and* Tangents; *ſuch as are the* Sectors, Scales, *the* Spiral Line, *&c. And others ſerving to repreſent the* Globe: *Such as be the* Mathematical Jewel, Aſtrolabium Catholicum, *and ſeveral other Projections of the* Sphere. *But none hath as yet Taught the Solution of* Spherical Triangles *by the* Globe *it ſelf; tho' it be the moſt Natural, and moſt Demonſtrative Way of all, and indeed, ought firſt to be learnt before the Learner enters upon any other Way.*

To this, Authors of Trigonometry *agree; for the moſt of them, in their Books, give Caution, that the Learner be already*

already ſufficiently grounded in the Principles of the Globe: *For thoſe* Lines *or* Circles, *which either in* Tables *or other* Inſtruments *you force your Imagination to conceive, repreſent your* Line *or* Circle *in Queſtion*; *thoſe* Lines *and* Circles (*I ſay*) *you have Actually and Naturally deſcribed on the* Globe, *and therefore may at a Single* Operation, *or perhaps only by a ſudden* Inſpection, *have an* Anſwer *annexed, according as the Nature of your* Queſtion *ſhall require*; *and that more Copiouſly, than by* Tables *of* Sines *and* Tangents: *For therein you find but one* Queſtion *at once Reſolved*; *but by the* Globe, *you have always two Reſolved together.*

Of the Parts *and* Kinds *of* Spherical Triangles.

THEOREMS.

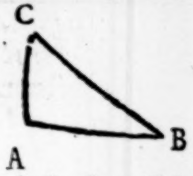
1. ALL *Spherical Triangles* are made of ſix Parts; three Sides, and three Angles. The Sides are joined together at the Angles, and meaſured by Degrees of a Great Circle from one end to the other. The Angles are the diſtance of the two joined Sides: And they are alſo meaſured by an Arch of a Circle, deſcribed on the *Angular Point*. If any three of theſe Parts be known, the reſt may be found.

2. All *Spherical Triangles* are either Right Angled, or Oblique Angled. A Right Angle contains 90 Degrees; an Oblique Angle either more, or leſs.

3. If a *Spherical Triangle* have one or more Right Angles, it is called a *Right Angled Spherical Triangle*: But if it have no Right Angle, it is called an *Oblique Angled Spherical Triangle*.

4. If an *Oblique Spherical Triangle* have one Angle greater than a Right Angle, it is called an *Obtuſe Angled Spherical Triangle*: But if it have no Angle greater, it is called an *Acute Angled Spherical Triangle*.

5. In *Right Angled Triangles*, the Sides including the Right Angle, are called Legs: And the Side oppoſite to the Right Angle



gle is called *Hypothenuſa.* Thus the Sides A B and A C, in the following Triangle, are called Legs; and the Sides B C, is called *Hypothenuſa.*

6. In a *Right Angled Spherical Triangle* one of the Legs are called Baſe; the other Perpendicular: Thus the Leg A B is Baſe, and the Leg C A Perpendicular. But the Terms may be varied; for the Baſe may be made Perpendicular, and the Perpendicular Baſe. Alſo one of the Adjacent Angles is called the *Angle at the Baſe*; the other the *Angle at the Perpendicular:* Thus the Angle B is called the *Angle at the Baſe:* The Angle C the *Angle at the Perpendicular.*

PROB. II.

The Legs of a Right Angled Spherical Triangle given, to find the Hypothenuſa, *and the two other Angles.*

THE Baſe of a Right Angled Spherical Triangle ſhall in this following Treatiſe be always placed on a *Meridian*, the *Perpendicular* on the *Equator*, the *Hypothenuſa* on the *Quadrant of Altitude*, and the Angle at the Baſe ſhall be meaſured in an Arch of the *Horizon.*

Elevate the Equinoctial into the *Zenith*, ſo ſhall the Poles of the Globe lye in the *North* and *South* Points of the *Horizon.*

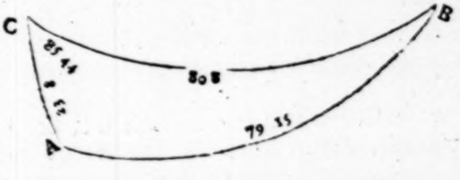
Then count from the Equinoctial on the *Meridian*, if you uſe the *Terreſtrial Globe*; or on the *Vernal Colure*, if you uſe the *Cœleſtial*, becauſe they are divided from the Equinoctial, either way, into 90 Degr. and becauſe from thence the Degr. of the Equinoctial are begun to be numbred: Count (I ſay) from the Equinoctial the number of Degr. the Baſe contains, and there make a Prick: Then count in the Equinoctial from the firſt Meridian, the number of Degr. the Perpendicular contains, and make there a Second Prick: Bring that Second Prick to the *Brazen Meridian*, ſo ſhall the firſt *Meridian* be ſeparated from the *Brazen Meridian* by the quantity of an Arch, equal to the meaſure of the *Perpendicular:* Then having the *Quadrant of Altitude* ſcrewed in the *Zenith*, turn it about till the Side of it cut the Prick made in the firſt Meridian; ſo ſhall the

Triangle be repreſented on the *Globe*. The *Baſe* ſhall lie on the *Firſt Meridian* between the *Equinoctial* and the *Quadrant of* Altitude, the *Perpendicular* in the *Equinoctial* between the *Firſt Meridian* and the *Brazen Meridian*; and the *Hypothenuſa* on the *Quadrant of Altitude* between the *Zenith* and the *Firſt Meridian*; and the number of Degrees between each of theſe reſpective *Arches* ſhall be the Meaſure of each reſpective *Side*. For the *Angles*; The *Right Angle* is known to be 90 Degrees, by the Second *Theorem* in the *Preface*. The Meaſure of the *Angle* at *Perpendicular* is numbred between the *Eaſt* Point in the *Horiz.* and the Graduated edge of the *Quadrant of Altitude*: But to find the *Angle* at the *Baſe* you muſt turn the *Triangle*, making the *Perpendicular Baſe*, and the *Baſe Perpendicular*.

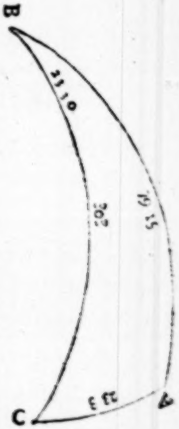
Example.

Having the two *Legs* given AB 79 Degrees 15 Minutes, and CA 23 Degrees 8 Minutes, I would find the Meaſure of the *Hypothenuſa* CB, and the *Angles* B, C.

The *Equinoctial* Elevated as before, I make AB *Baſe*, and CA *Perpendicular*, counting in the *Firſt Meridian* from the *Equinoctial* 79 Degrees 15 Minutes, and there I make a Prick: Then I number in the *Equinoctial* from the *Firſt Meridian* 23 Degrees 8 Minutes the Length of the *Perpendicular*, and there I make a Second *Prick*: This Prick I bring to the *Brazen Meridian*, ſo is the *Firſt Meridian* ſeparated from the *Brazen Meridian* ſo many Degrees and Minutes as is the Length of the *Perpendicular* CA: Then I ſcrew the *Quadrant of Altitude* to the *Zenith*, *viz.* directly over the *Equinoctial*, and move it about till the Edge of it touch the Prick made in the *Firſt Meridian*: So is the *Triangle* made on the *Globe*: And the number of Degrees and Minutes of the *Quadrant of Altitude* comprehended between the *Firſt Meridian* and the *Zenith* is the Meaſure of the *Hypothenuſa* CB; which in this *Example* is 80 Degrees 8 Minutes: The number of Degrees in the *Horizon* compre-



hended between the *Equinoctial* and the *Quadrant of Altitude* is the Meaſure of the *Angle* C, 85 Degrees, 44 Minutes: the *Angle* A is a *Right Angle* 90 Degrees: And to find the *Angle* B Turn the *Triangle* (all but the Letters): Thus as before A C was *Baſe*, ſo now I make B A *Baſe*, and as before A B was *Perpendicular*, ſo now C A ſhall be *Perpendicular*: ſo is your *Triangle* Turned.



Now, as before I counted 79 Degrees 15 Minutes from the *Equinoctial* on the *Firſt Meridian*, which was the Length of that *Baſe*, ſo now I count 23 Degrees 8 Minutes on the *Firſt Meridian*, which is the Length of this *Baſe*, and there (as before) I make a Prick; and as before I counted 23 Degrees 8 Minutes on the *Equinoctial* from the *Firſt Meridian*, which was the Length of that *Perpendicular*; ſo now I count 79 Degrees 15 Min. on the *Equinoctial*, which is the Length of this *Perpendicular*; and there I make a Prick on the *Equinoctial*: Then I bring this Prick (as before to the *Brazen Meridian*, ſo ſhall the *Firſt Meridian* be diſtant (as before) from the *Brazen Meridian* ſo many Deg. and Min. as is the Length of this *Perpendicular*, *viz.* 79. 15. Then having the *Quadrant of Altitude* ſcrewed to the *Zenith*, I turn it about till the Edge of it touch the Prick made in the *Firſt Meridian* at 23. 8. diſtant from the *Equinoctial*; ſo is the *Triangle* Turned: And ſo ſhall the Arch of the *Horizon* comprehended between the *Equinoctial* and the *Quadrant of Altitude* be the Meaſure of the *Angle* B C. 23. 30. you alſo ſee the Meaſure of the *Hypothenuſa* B C 80. 8 on the *Quadrant of Altitude*, counted between the *Zenith* and the *Firſt Meridian*.

PROB. II.

A Leg *and the* Hypothenuſa *given, to find the Reſt.*

EXample. The *Leg* given ſhall be C A in the former *Triangle* 23 Degrees 8 Minutes. The *Hypothenuſa* C B 80 Degrees 8 Minutes. The *Equinoctial* and *Quadrant of Altitude* Rectified, as by the laſt Probleme, Number the *Leg* C A 23

Degrees 8 Minutes on the *Equinoctial* from the *Firſt Meridian*, and there make a Prick; Bring this Prick to the *Brazen Meridian*. Then number on the *Quadrant of Altitude* the *Hypothenuſa* BC 80 Degrees 8 Minutes from the *Zenith* towards the *Horizon*, and make there on the Edge of the *Quadrant of Altitude* another Prick: Then turn the *Quadrant of Altitude* about till the Prick made on the Edge of it touch the *Firſt Meridian*, ſo ſhall the *Triangle* be made: The *Arch* of the *Equinoctial* comprehended between the *Firſt Meridian* and the *Brazen Merid.* ſhall repreſent AC the *Perpendicular*; the *Arch* of the *Quadrant of Altitude* comprehended between the *Zenith* and the *Firſt Meridian* ſhall repreſent BC the *Hypothenuſa*; and the *Arch* of the *Firſt Meridian*, comprehended between the *Equinoctial* and the *Quadrant of Altitude* ſhall repreſent BA the *Baſe*, which was one *Leg* ſought, and is (as you will find) 79 Degrees 15 Minutes. The *Angle* C you will find in the *Horizon* 85 Degrees 44 Minutes: The *Angle* A is the *Right Angle* 90 Degrees: And to find the *Angle* B you muſt Turn the *Triangle*, as you were directed in the former Probleme.

PROB. III.

The Hypothenuſa *and an* Angle *given*, *to find the Reſt.*

THe *Hypothenuſa* given ſhall be BC of the *Triangle* in Prob. I. 80 Degrees 8 Minutes. The *Angle* given ſhall be C 85 Degrees 44 Minutes: The *Globe* and *Quadrant of Altitude* Rectified as by Prob. I. count the given *Angle* 85 Degrees 44 Minutes on the *Horizon* from the *Equinoctial*, and there place the *Quadrant of Altitude*: Then turn about the *Globe* till the *Firſt Meridian* touch 80 Degrees 8 Minutes of the *Quadrant of Altitude* counted from the *Zenith* downwards, ſo ſhall the *Triangle* be made on the *Globe*: The *Arch* of the *Equator* comprehended between the *Firſt Meridian* and the *Brazen Meridian* ſhall ſhew the Length of the *Perpendicular* CA 23 Degrees 8 Minutes; the *Arch* of the *Firſt Meridian* comprehended between the *Equinoctial* and the *Quadrant of Altitude* ſhall ſhew the Length of the *Baſe* AB 79 Degrees 15 Minutes, the *Right Angle* made at the Interſection of the *Brazen Meridian* and the *Equinoctial* is 90 Degrees: and to find the Meaſure of the *Angle* B you muſt Turn the *Triangle*, as you were directed Prob. 1.

PROB. IV.

A Leg *and* Angle *adjoyning given, to find the Reſt.*

IN the *Triangle* of Prob. 1. the *Leg* given ſhall be CA 23 Degrees 8 Minutes, the *Angle* adjoyning ſhall be C, 85 Deg. 44 Minutes: The *Globe* and *Quadrant of Altitude* Rectified, as by Prob. 1. I turn about the *Globe* till the *Firſt Meridian* be diſtant from the *Brazen Meridian* 23 Degrees 8 Minutes, the Length of the *Leg* CA: Then I count in the *Horizon* from the *Equinoctial* 85 Deg. 44 Minutes, the Meaſure of the *Angle* C; ſo is the *Triangle* made on the *Globe*. The *Arch* of the *Firſt Meridian* comprehended between the *Quadrant of Altitude* and the *Equinoctial* ſhall ſhew the Length of the *Baſe* AB 79 Degrees 15 Minutes; The *Arch* of the *Quadrant of Altitude* comprehended between the *Zenith* and the *Firſt Meridian* ſhall ſhew the Length of the *Hypothenuſa* CB 80 Degrees 8 Minutes; The *Right Angle* made at the Interſection of the *Equinoctial* and the *Brazen Meridian* is 90 Degrees: And to find the Meaſure of the *Angle* B, you muſt Turn the *Triangle*, as you were directed Prob. 1.

PROB. V.

A Leg *and the* Angle *oppoſite given, to find the Reſt.*

IN the *Triangle* of Prob. 1. the *Leg* given ſhall be AB 79 Degrees 15 Minutes, the *Angle* oppoſite ſhall be C 85 Degrees 44 Minutes. The *Globe* and *Quadrant of Altitude* Rectified, as by Prob 1. I bring the *Quadrant of Altitude* to 85 Degrees 15 Minutes of the *Horizon*, the Meaſure of the *Angle* C: Then I Turn the *Globe* till 97 Degrees 15 Minutes of the *Firſt Meridian* (which is the Meaſure of the *Leg* AB) touch the *Quadrant of Altitude*, ſo is the *Triangle* made on the *Globe*. The *Arch* of the *Equinoctial* comprehended between the *Firſt Meridian* and the *Brazen Meridian* ſhews the Length of the *Leg* C A 23 Degrees 8 Minutes; the *Arch* of the *Quadrant of* Altitude comprehended between the *Zenith* and the *Firſt Meridian*, ſhall ſhew the Length of the *Hypotheneſa* CB 80 Deg. 8 Minutes: The *Right Angle* made at the Interſection of the *Equinoctial* and the *Brazen Meridian* is 90 Degrees: And to find the Meaſure of the *Angle* B, you muſt Turn the *Triangle*, as you were directed in Prob. 1.

PROB. VI.

The Angles *given to find the* Sides.

IN this *Caſe* you muſt Turn the *Angles* into *Sides*, making an *Oblique Triangle* on the *Globe*, whoſe *Sides* ſhall be equal to the given *Angles:* ſo ſhall the *Angles* of this *Triangle* found, be the Meaſure of the *Sides* required.

Example.

In the *Triangle* of Prob. 1. The *Angle* A is 90 Degrees, the *Angle* B 23 Degrees 30 Minutes, the *Angle* C 85 Degrees 44 Minutes: The *Globe* and *Quadrant of Altitude* Rectified as by Prob. 1. I ſet the *Right Angle* A 90 Degrees on the *Brazen Meridian* between the *Pole* and the *Equinoctial*; For the *Angle* B, I number downwards on the *Quadrant of Altitude* 23 Degrees 30 Minutes, which ſhall be the *Side* repreſenting that Angle: for the *Angle* C I number on the *Firſt Meridian* from the *Pole* towards the *Equinoctial* 85 Degrees 44 Minutes, which ſhall be the *Side* repreſenting that *Angle*: Then I turn the *Globe* and *Quadrant of Altitude* till I can join the 23 Degrees 30 Minutes (counted before on the *Quadrant of Altitude*) and this 85 Deg. 44 Minutes (counted in the *Firſt Meridian*) together; So is a *Triangle* made on the *Globe*; whoſe *Sides* being equal to the *Angles* given, ſhall have its *Angles* equal to the *Sides Required*: Thus the *Arch* of the *Equinoctial* contained between the *Firſt Meridian* and the *Brazen Merid.* ſhall be found 23. 8. the Meaſure of the *Side* AC: the *Arch* of the *Horizon* between the neareſt *Pole* and the *Quadrant of Altitude* ſhall be found 79. 15. the Meaſure of the *Side* BA: And to find the *Hypothenuſa* BC, you have now *Data's* enough; either to find it as by ſome of the former Problems; or elſe you may find it by Turning the *Triangle*; as by Prob. 1.

Theſe *Caſes* of *Right Angled Spherical Triangles* may be Wrought otherwayes by the *Globe*, if you alter its Poſition, making the *North* or *South* Points of the *Horizon Zenith*; or elſe the *Poles* of the *World*, or the *Poles* of the *Eclipticky*; and uſe the *Circle of Poſition* inſtead of the *Firſt Meridian* or Circles of *Longitude*. But theſe Inſtructions, together with a little Practice are (I judge) ſufficient: Therefore I ſhall refer Varieties to the Studies of the induſtrious Student.

Of

Of Oblique Triangles.

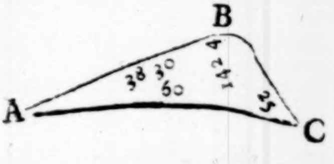
PROB. VII.

The three Sides *given, to find the* Angles.

Elevate the *Pole* of the *Globe* above the *Horizon* to the complement of one of the given *Sides*, and ſcrew the *Quadrant of Altitude* in the *Zenith*, ſo ſhall that given *Side* be comprehended between the *Pole* and the *Quadrant of Altitude*; Then count from the *Pole* upon the *Firſt Meridian* the Meaſure of the Second *Side*; and there make a Prick: Count alſo from the *Zenith* upon the *Quadrant of Altitude* downwards the Meaſure of the Third *Side*, and make there on the Edge of the *Quadrant of Altitude* another Prick; Then turn the *Globe* and *Quadrant of Altitude* till you can joyn theſe two Pricks together, ſo ſhall your *Triangle* be made on the *Globe:* And then the number of Degrees of the *Equinoctial* comprehended between the *Firſt Meridian* and the *Brazen Meridian* ſhall be the Meaſure of the *Angle* at the *Pole*: The *Arch* of the *Horizon* contained between the *Quadrant of Altitude* and the interſection of the *Brazen Merid* with the *Horizon* on the ſide the *Pole* is Elevated, ſhall be the Meaſure of the Second *Angle*. For finding the Third, Turn the *Triangle*, as by Prob. I.

Example.

In the *Triangle* A B C annexed, the *Side* A B contains 38 Degrees 30 Minutes, the *Side* B C 25 Degrees, and the *Side* A C 60 Degrees: I would Meaſure theſe Angles; I place one of theſe *Sides* upon the *Merid. viz.* A B 38. 30. The Complement of 38 30. is 51 De. 30 M. Therefore I Elevate the *Pole* 51. 30. above the *Horiz* ſo ſhall the *Zenith* be diſtant from the Pole 38. 30. here I ſcrew the *Quad. of Altitude* in the *Zenith* and count downwards on it the Meaſure of the *Side* B C 25 Deg. and there I make a Prick: then from the *Pole*



I count on the *Firſt Meridian* 60 Deg. the Meaſure of the *Side* AC, and there I make another Prick: Then I turn the *Globe* and *Quad. of Altitude* backwards or forwards till theſe two Pricks are joyned together; ſo ſhall the *Triangle* A B C be made on the *Globe*: The *Arch* of the *Brazen Meridian* comprehended between the *Pole* and *Zenith* ſhall repreſent the *Side* A B; the *Arch* of the *Quadrant of Altitude* comprehended between the *Firſt Meridian* and the *Brazen Meridian* ſhall repreſent the *Side* B C; and the *Arch* of the *Firſt Merid.* comprehended between the *Pole* and the *Quadrant of Altitude* ſhall repreſent the *Side* A C; The *Pole* ſhall repreſent the *Angle* A, the *Zenith* the *Angle* B, and the interſection of the *Firſt Meridian* with the *Quadrant of Altitude* ſhall repreſent the *Angle* C. The *Angle* at the *Pole* is Meaſured in the *Equator*; for the Degrees comprehended between the *Firſt Meridian* and the *Brazen Meridian* being 17 Degrees 15 Min. ſhews 17 Degrees 15 Minutes to be Meaſure of the *Angle* A: The *Angle* at the *Zenith* is Meaſured in the *Horizon*, for the Degrees comprehended between the Interſection of the *Brazen Meridian* with the *Horizon* on that *Side* the *Pole* is *Elevated* being 142 Degrees 42. Minutes, ſhews that 142 Degrees 42 Minutes is the Meaſure of the *Angle* B, Thus two *Angles* are found; the Third is wanting: which I find thus,

I Turn the *Triangle*, placing either A or C in the *Zenith*. *Example*. I place A at the *Zenith*, which before was at the *Pole*; ſo ſhall C be at the *Pole* and B at the Interſection of the *Firſt Merid.* and the *Quadrant of Altitude*, and the *Side* A C ſhall be comprehended between the *Pole* and *Zenith*: The *Side* AC contains 60 Degrees; its Complement to 90 is 30 Degrees: therefore I Elevate the *Pole* of the *Globe* 30 Degrees above the *Horizon*; ſo ſhall 60 Degrees be in the *Zenith*; therefore to 60 Degrees I ſcrew the *Quadrant of Altitude* and count on it downwards the meaſure of the other *Side* next the *Zenith*, *viz.* 38 Degrees 30 Minutes; and there I make a Prick: Then from the *Pole* on the *Firſt Meridian* I count the Meaſure of the Laſt *Side*, *viz.* 25 Degrees, and there I make another Prick: Then I turn the *Globe* and *Quadrant of Altitude* (as before) till theſe two Pricks joyn; ſo is the *Triangle* Altered on the *Globe*: For the *Arch* of the *Brazen Meridian* comprehended between the *Pole* and *Zenith* which before was 38 Degrees 30 Minutes is now 60 Degrees; the *Arch* of the *Quadrant of Altitude* comprehended between the *Firſt Meridian* and the *Brazen Meridian*, which before was 25 Degrees, is now 38 Degrees 30 Minutes, and the *Arch* of the *Firſt Meridian* comprehended between the *Quadrant of Altitude* and the *Pole*, which before was 60 Degrees is now 25 Degrees. Thus the *Angle* C being now at the *Pole*, its Meaſure is found in the *Equinoctial*, *viz.* the *Arch* comprehended between the *Firſt Meridian* and the *Brazen Meridian* which is 25 Deg. 24 Minutes, and the Meaſure of the *Angle* A, which is now in the *Zenith*: having its *Sides* the one an Arch of the *Brazen Meridian* the other an *Azimuth* (or which is all one) an *Arch* of the *Quadrant of Altitude*, is Meaſured in the *Horizon*, as all *Azimuths* are, and found 17 Degrees 15 Minutes, as before.

PROB. VIII.

Two Sides *and the* Angle *contained between them given to find the Reſt.*

EXample, in the former *Triangle* I have given the *Sides* A B, 38 Deg. 30 Min. AC, 60 Deg. and the *Angle* A 17 Deg. 15 Min. I Elevate the *Pole* of the *Globe* to the Complement of one of the given *Sides*; ſuppoſe the *Side* A B, which being 38 Deg. 30 Minutes Complement to 90 Deg. is 51 Deg. 30 Min. ſo ſhall the *Zenith* be diſtant from the *Pole* 38 Deg. 30 Min. the Meaſure of the *Side* A B: The other *Side* is 60 Deg. this 60 Deg. I count from the *Pole* in the *Firſt Meridian*, and there I make a Prick: The *Angle* given is 17 Deg. 15 Min. this I count in the *Equinoctial* from the *Firſt Meridian*, and this Degree and Minute in the *Equinoctial* I bring to the *Brazen Meridian*, ſo ſhall the *Firſt Meridian* be ſeparated from the *Brazen Meridian* 17 Deg. 15 Min. Then I ſcrew the *Quadrant of Altitude* to the *Zenith*, and bring the *Side* of it to the Prick made in the *Firſt Meridian*: ſo ſhall the *Triangle* be made on the *Globe*. Then to find the unknown *Side* BC, I count the number of Deg. on the *Quadrant of Altitude* contained between the *Zenith* and the *Firſt Meridian*, and find 25 which is the Meaſure of the *Side* BC: To find the Meaſure of the *Angle* B, I count the number of Degrees contained between the interſection of the *Merid.* with the *Horizon* on that ſide the *Pole* is Elevated and the *Quadrant of Altitude*, and find 142 Deg. 42 Min. which is the Meaſure of the *Angle* B: And to find the *Angle* C, I turn the *Triangle*, as in Prob. 7.

PROB.

PROB. IX.

Two Sides and an Angle oppoſite to one of them given, to find the Reſt.

E*Xample.* In the *Triangle* in *Prob.* 7. the Sides given are A B 38 *Degrees* 30 *Minutes*, and A C 60 *Degrees:* The *Angle* given, oppoſite to A C is B 142 *Degrees* 42 *Minutes:* I elevate the Pole to the Complement of one of the given *Sides*; ſuppoſe A B, which being 38 *Degrees* 30 *Minutes*, its Complement to 90 *Degrees* is 51 *Degrees* 30 *Minutes*; ſo is the Zenith diſtant from the Pole 38 *Degrees* 30 *Minutes.* To this 38 *Deg.* 30 *Minutes* I ſcrew the *Quadrant of Altitude*, and count in the Horizon from the Interſection of the Meridian with the Horizon, on that ſide the Pole is Elevated, the Meaſure of the given *Angle* B, *viz.* 142 *Degrees* 42 *Minutes*, and to this number of *Degrees* and *Minutes* of the Horizon, I bring the Edge of the *Quadrant of Altitude*; then I count in the firſt Meridian from the Pole, the Meaſure of the Side A C 60 *Degrees*; and there I make a Prick, and turn about the *Globe*, till that Prick come to the Edge of the Quadrant of Altitude, ſo is the *Triangle* made on the Globe: The *Degrees* of the Quadrant of Altitude, comprehended between the Firſt Meridian, and the Zenith, being 25 *Degrees*, is the Meaſure of the Side B C: The *Degrees* of the Equinoctial, comprehended between the firſt Meridian, and the Brazen Meridian, being 17 *Degrees* 15 *Minutes*, is the Meaſure of the *Angle* A; and for finding the Meaſure of the *Angle* C, I turn the *Triangle*, as in *Prob.* 7.

PROB. X.

Two Angles and the Side comprehended between them given, to find the Reſt.

E*Xample.* In the *Triangle* of *Prob.* 7. the *Angles* given are A 17 *Degrees* 15 *Minutes*, and B 142 *Degrees* 42 *Minutes*, the Side comprehended between them is A B 38 *Degrees* 30 *Minutes*: I elevate the Pole to the Complement of the Side A B, which being 38 *Degr.* 30 *Min.* its Complement to 90 *De-*

grees is 51 degrees 30 minutes, ſo is the Zenith diſtant from the Pole 38 degrees 30 minutes; to this 38 degrees 30 Minutes, I ſcrew the *Quadrant of Altitude*, and count in the *Horiz.* from the Interſection of the *Meridian*, with the *Horizon* on that ſide the Pole, is Elevated the Meaſure of the given Angle B, *viz.* 142 degrees 42 minutes, and to this number of degrees and minutes of the *Horizon*, I bring the Edge of the *Quadrant of Altitude*; then I turn about the Globe, till the firſt *Meridian* is diſtant from the *Brazen Meridian* 17 degrees 15 minutes of the *Equinoctial*, which is the Meaſure of the other given Angle; ſo ſhall the Triangle be made on the Globe; and the *Arch of the Quadrant of Altitude* comprehended between the firſt Meridian and the Zenith, ſhall be the Meaſure of the Side B C 25 degrees, and the Arch of the firſt *Meridian*, comprehended between the Pole and its Interſection with the *Quadrant of Altitude*, ſhall be the Meaſure of the Side A C 60 degrees. The Meaſure of the Angle C is found by Turning the *Triangle*, as in *Prob.* 7.

PROB. XI.

Two Angles and a Side oppoſite to one of them given, to find the reſt.

EXample. In the Triangle of *Prob.* 7. the Angles given are A 17 degr. 15 Min. and B 142 degr. 42 Min. the Side given is B C 25 degr. being the Side oppoſite to the Angle A; the Angle A is made at the Pole of the Globe, and meaſured in the *Equator*: Therefore I ſeparate the firſt Meridian from the Brazen Meridian 17 degr. 15 min. ſo doth the Pole repreſent the Angle A; the Angle B is made at the Zenith, and meaſured in the Horizon; therefore I count the Horizon 142 degr. 42 min. and there I make a Prick; to this Prick I bring the Edge of the lower end of the *Quadrant of Altitude*, (not minding to what Degrees of the Meridian the upper end of it is placed) then I count from the upper end of the *Quadrant of Altitude* 25 deg. downwards, the Meaſure of the Side B C, and there I make a Prick, and keeping the lower end of the *Quad. of Altitude* to the Prick made in the Horiz. I ſlide the upper end of it, forwards or backwards, till the Prick on the *Quad. of Altitude* come to the firſt Merid. ſo ſhall the Triangle be made on the *Globe:* Then the Arch of the Brazen Meridian, comprehended between the Pole, and the upper end of the *Quadrant of Altitude*, ſhall be the Meaſure of the Side A B 38 degr. 30 min. and the Arch of the firſt Meridian, comprehended between the Prick on the *Quadrant of Altitude*, and the Pole, ſhall be the Meaſure of the Side A C 60 degr. But the Angle C you muſt find, by turning the Triangle, as in *Prob.* 7.

In the working this *Probleme*, I would have placed the given Side B C 25 degr. upon the Brazen Meridian, between the Pole and Zenith; but then the Angle B (being ſo obtuſe) would have had that Side, which would be Interſected by the *Quadrant of Altitude*, (*viz.* the firſt Meridian) under the Horizon, which the *Quadrant of Altitude* cannot reach.

PROB. XII.

Three Angles given, to find the Sides.

THis Triangle is taught to be reſolved by Mr. *Palmer* on the Planiſphere, *Book* 3. *Chap.* 19.

It is to be known, (ſaith he) that if you go to the Poles of the three great Circles, whereof your Triangle is made, theſe Poles ſhall be the Angular Points of a Second Triangle, and the two leſſer Sides of this Second *Triangle* ſhall be equal to the two leſſer *Angles* of your firſt *Triangle*. The greateſt Side of the Second *Triangle*, ſhall be the Supplement of the greateſt *Angle* of the Firſt Triangle, (that is, ſhall have as many *degr.* and *min.* as the greateſt *Angle* of the Firſt *Triangle* wanted of 180 *degr.*) See *Pitiſcus Trigonometry*, *Lib.* 1. *Prob.* 61.

This Second *Triangle* therefore (all, whoſe Sides are known from the *Angle* of the Firſt) you ſhall reſolve by *Prob.* 7. and having by that *Probleme* found the *Angles* of the Second *Triangle*, know, that the two leſſer *Angles* of the Second *Triangle* ſhall be ſeveral, and reſpectively equal to the two leſſer Sides of the Firſt *Triangle*, (and the leaſt *Angle* to the leaſt Side, the middle *Angle* to the middle Side) and the greateſt *Angle* of this Second *Triangle*, being Subtracted out of 180 *Degr.* ſhall leave you the Greateſt Side of your Firſt *Triangle*.

Example. If the *Angles* be given 142 *Degrees* 42 *Minutes*, 17 *Degrees* 15 *Minutes*, and 25 *Degrees* 24 *Minutes*; and the

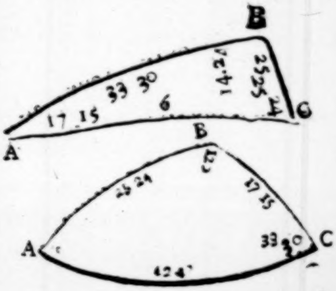
Sides be enquired. Draw by aim a rude Scheme of this firſt *Triangle*, writing in the *Angle* A 17 *deg.* 15 *min.* in B 142 *deg.* 42 *min.* in C 25 *deg.* 24 *min.* ſuppoſing the Sides yet unknown: Then draw under this by aim alſo, a Scheme of the ſecond *Triangle*, ſetting his Baſe Parallel with the Baſe of the firſt, and making the Baſe of the ſecond ſhorter than the Baſe of the firſt. Set alſo B at the *Vertical Angle*, and A C at the Baſe, as in the firſt *Triangle*. Then ſay,.

Becauſe A in the firſt *Triangle* is 17 *deg.* 15 *min.* therefore in the ſecond *Triangle* B C (which Subtendeth A) ſhall be 17 *deg.* 15 *min.* and becauſe C in the firſt *Triangle* is 25 *deg.* 24 *min.* therefore in the ſecond *Triangle* the Side A B (which Subtendeth C) ſhall be 25 *deg.* 24 *min.* And becauſe B, the the greateſt *Angle* in the firſt *Triangle*, is 142 *deg.* 42 *min.* therefore in the ſecond *Triangle*, the Side A C (which Subtendeth B) ſhall be the Complement thereof to 180 *Deg. viz.* 37 *deg.* 18 *min.* Write now upon the Sides of this ſecond *Triangle* the Quantities of the Sides, ſo is your ſecond *Triangle* ready to be Reſolved, as by *Prob.* 7. whereby you ſhall find the *Angles* of the ſecond *Triangle*, as I have expreſſed them in the Scheme; A 25 *deg.* C 38 *deg.* 30 *min.* B 120 *deg.*

Now laſtly, I ſay, theſe *Angles* of the ſecond *Triangle* thus found, give me the Sides of the firſt *Triangle*, which I ſeek, in this manner.

In the ſecond *Triangle*.	In the firſt *Triangle*.
A is 25 *Degrees*.	B C is 25 *Degrees*.
C is 38. 30.	A B 38. 30.
B is 120. 00.	Therefore A C 60. 00. Complement

of 120 *Degrees* to 180. And thus by all the *Angles* given, we have found out all the Sides, which was required.



Having then the *Angles* of your firſt *Triangle* given, and his Sides now found; you ſhall find his Situation on the Globe thus: Place him as in *Prob.* 7. A B 38 Degrees 30 Minutes between the Pole and Zenith, A C 60 *Degrees* in the firſt Meridian, ſeparated from the Brazen Meridian 17 *Degrees* 15 *Minutes* of the Equinoctial, B C 25 Degrees on the Quadrant of Altitude, counted from the *Zenith*, when its lower end is applied to 142 *Deg.* 42 *Min.* of the Horizon; you ſhall ſay, becauſe the *Eaſt* Point of the Horizon is the Pole of the Arch A B, therefore at the *Eaſt* Point of the Horizon ſhall ſtand the *Angle* C, which A B Subtendeth: Then number from the Quadrant of Altitude 90 *Deg.* on the Horizon Eaſtwards, and there is the Pole of the Arch B C: Therefore there ſhall ſtand the *Angle* A, which B C Subtendeth. Theſe 90 *Deg.* will end at 37 *Deg.* 18 *Min.* counted from the *Eaſt* Point of the Horizon *Northwards*; then count in the Equator from the firſt Meridian 90 *Deg.* which will end under the Horizon, and there make a Prick; for there is the Pole of the Arch or Side A C. Therefore at that Prick ſhall ſtand the *Angle* B, which A C Subtendeth.

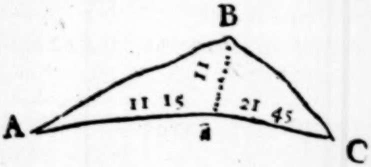
Here you ſee your Second *Triangle*, made by the Poles of the Firſt, adjoining to the *Eaſt* Point of the Globe; only the Side A B is wanting: To get that, make a Prick upon the Globe againſt the 37 *Deg.* 18 *Min.* from the *Eaſt* Point of the *Horiz. Northwards*, found before, to repreſent the *Angle* A: Then turn about the Globe and Quadrant of Altitude, till that Prick, and the Prick made before for the *Angle* B, are both at once cut by the Side of the Quadrant of Altitude, and you will find 25 *Deg.* 24 *Min.* of the Quadrant of Altitude, comprehended between the two Pricks, for the Meaſure of the Side A B.

PROB. XIII.

How to let fall a Perpendicular *that ſhall Divide any Oblique Spherical* Triangle, *into two Right Angled Spherical Triangles.*

THis *Probleme* is much uſed, when an *Oblique Triangle* having two Sides and an *Angle* given, is to be Solved by the Canon of *Sines* and *Tangents*: But by the Globe it may be Solved without it, as was ſhewed *Prob.* 8, 9. Yet becauſe Letting fall a *Perpendicular*, is ſo frequent in all Authors that treat of *Trigonometry*, I have inſerted this Probleme alſo.

In



In the *Oblique Triangle* of the former Problemes, there is given the Sides A B 38 ½ *deg.* and B C 25 *deg.* and the *Angle* C 25 *deg.* 24 *min.* It is required to let fall a *Perpendicular*, as B *a* from the *Angle* B, upon the Baſe A C, and to know both the Meaſure of this *Perpendicular*, and the parts it divides the Baſe into.

Therefore Elevate the Pole of the Globe above the *Horizon* ſo much as is the Meaſure of the *Angle* C, which in the *Example* is 25 *deg.* 24 *min.* and bring the Interſection of the firſt Merid. with the *Equinoctial*, to the *Eaſt* Point in the *Horizon*; ſo ſhall the *Angle*, at the *Eaſt* Point of the *Horizon*, comprehended between the *Horizon*, and the firſt Meridian, be equal to the *Angle* C; then count in the firſt Meridian, from the *Eaſt* Point of the *Horizon*, the Meaſure of the Side B C 25 *deg.* and having the Quadrant of Altitude ſcrewed to the *Zenith*, bring the Graduated Edge of it to theſe 25 *deg.* ſo ſhall the Arch of the *Horizon*, comprehended between the *Eaſt* Point and the lower end of the Quadrant of Altitude, be the number of *deg.* that the *Perpendicular* falls upon the Baſe, counted from the *Angle* C to *a*, which in this *Example* is 21 ¾ *deg.* and the Arch of the Quad. of Altitude, comprehended between the *Horizon* and the firſt Meridian, is the Meaſure of the *Perpendicular* B *a* 11 *deg.*

And thus, by letting fall this *Perpendicular*, you have two Right Angled Spherical Triangles made; the one B *a* C, wherein is found C *a* 21 ¾ *deg.* B C 24 *deg.* B *a* 11 *deg.* C 25 *deg.* 24 *min.* and *a* the *Right Angle*: There remains only the *Angle* B unknown, which you muſt find, by turning the *Triangle*, as was taught, *Prob.* 1. The other *Right Angled Spherical Triangle* made, is B *a* A, wherein is found A *a*, Complement of 21 ¾ *deg.* to 60 *deg.* (the whole Baſe before given) 38 ¼ *deg.* A B 38 *deg.* 30 *min.* B *a* 11 *deg.* and *a* the *Right Angle*, which is more than enough to find the *Angles* A and B, as was ſhewed in the *Preface*, *Theorem* 1.

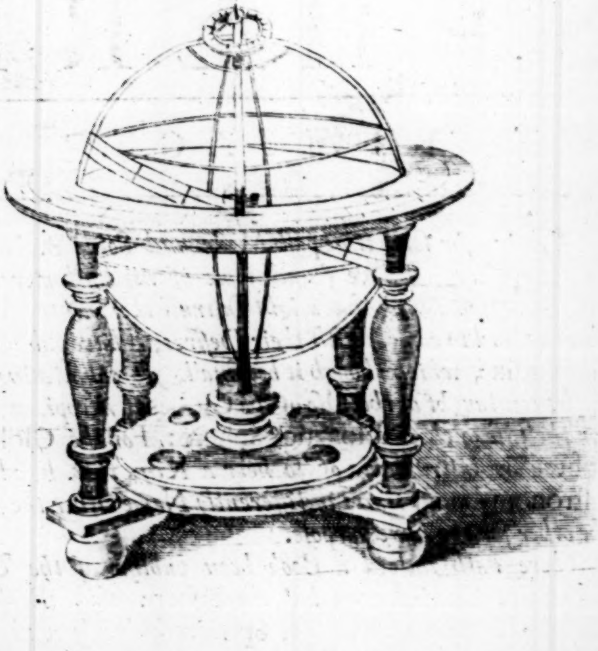
The End of the Sixth Book.

AN
APPENDIX,
Shewing the
EXPLANATION and USE
OF THE
PTOLOMAICK
SPHERE.

PRÆFACE.

H*Aving for ſome time paſt Made and Sold* Ptolomaick Spheres, *I have found ſome of my Cuſtomers much deſirous of ſomething that might Inſtruct them in the Uſe of them; And to comply with their Deſires, I have publiſht this* Appendix; *which though it be ſmall, yet conſidering what hath been taught of the Uſe of the* Globes, *it is copious enough for the Uſe of the* Ptolomaick Sphere: *For the* Globe *and* Sphere *are Inſtruments of ſo near a Kin, that Readers of* Aſtronomy *many times indifferently Name either the one or the other for the ſame purpoſe.*

There hath indeed a Book been publiſht of the Uſe of the Ptolomaick Sphere; *but the* Sphere *that Book was made for, differs from the* Spheres *Vulgarly made: For* *that* Sphere *was purpoſely made for* Prince Henry, *eldeſt Son to King* James *of bleſſed Memory, and no coſt ſpared to make it either Uſeful or Beautiful; as may yet be ſeen by the Inſtrument it ſelf; it being lately in the poſſeſſion of Sir* Jonas More *in the* Tower *of* London, *and therefore would be too dear for general Sale. But the* Spheres *for which this* Appendix *is deſigned, is the Common* Ptolomaick Sphere; *by which* Sphere, *after a Practitioner grows a little familiar with the Conſtitution of the* Heavens, *he may ſufficiently conceive how the* Zodiacal *and* Ecliptical *motions of the* Planets *are made: And alſo in what Places of their ſeveral* Orbs *their* Perigeums *and* Apogeums *will fall out.*



What a Sphere *is.*

I Told you in the firſt Chapter of the firſt Book, that a *Globe* according to the *Mathematical* definition is a perfect and exact round Body, contained under one Surface. The definition of a *Sphere* is the ſame. So then, the *Globe* and *Sphere* as they are *Geometrick* Bodies are alſo the ſame. Yet, as they are *Aſtronomical* Inſtruments there is a difference in them: For as a *Sphere* is an *Aſtronomical* Inſtrument, it is a complication of material Circles only, ſo fitted together that they repreſent all the Imaginary Circles and Motions of the Eighth *Sphere*, and the Circles and Motions of all the *Planets* about the *Earth*. Therefore on this material *Sphere* you can neither have all the *Conſtellations* and *Stars*, nor the ſhape of the *Earth*, *Waters*, *Towns*, &c. depicted: Becauſe of the vacuities between the ſeveral Circles. Yet is the *Sphere* applicable to almoſt all the *Aſtronomical* Uſes the *Celeſtial* and *Terreſtrial Globes* are: And in ſome caſes more apt to repreſent the Order and Appearance of the *Planetary Orbs*. For thereon have you repreſented the *Zodiack*, the *Equinoctial*, the *Colures*, the *Tropicks*, the *Polar Circles*, the *Meridian*, the *Horizon*, *Verticle Circle*, *Hour-Circle*, &c. juſt in the ſame manner and order they are on the *Celeſtial* and *Terreſtrial Globe*; and therefore I refer you to the ſeveral definitions in the firſt Book: Only with this difference, that where you find *Globe* you read *Sphere*.

And as the Circles of the *Globe* and *Sphere* are the ſame, ſo is the manner of working with the *Globe* and *Sphere* the ſame; and the Precepts you find in the ſeveral Problems throughout this Book that relate only to the Circles, you find in the *Sphere*, ſerve indifferently and in the ſame manner for the *Sphere*, if (as was ſaid) you only read *Sphere* where you find *Globe*. This I ſhall paſs by without farther inlarging on, becauſe it is ſo plain: and ſhall come to ſhew you in what reſpect a *Sphere* is more apt to repreſent the Order and Appearance of the *Planetary Orbs* than a *Globe* is. And that is, becauſe a *Sphere* is complicated only of Lath-like Circles to repreſent each *Orb*, and is not an intire *Orb* as a *Globe* is, ſo that you may ſee the ſeveral Fabrications that are made within it. But if the *Sphere* were made of intire *Orbs* you could ſee only the outmoſt *Orb*, not any of the inner Facations: as we may ſee in an *Onyon*, which though it be made up of ſeveral *Orbs* the one within another, as the whole *World* is of many *Heavens* or *Orbs* one within another: Yet can we only ſee the utmoſt *Orb* or Scale of the *Onyon*, that wrapping up and hiding all the other from our Eyes. So that all the *Orbs* (as we muſt call them) of the *Sphere* are not real *Orbs*, but ſerve only for the repreſentation of *Orbs*.

Beſides, you have every *Planet* repreſented in an *Orb* by it ſelf, and that in the ſame Order that it is ranked in Heaven.

As Firſt the outmoſt *Orb* of all, which repreſents the *Orb* of the *Eighth Heaven*, or *Starry Heaven*, conſiſts of the two *Colures*, which are thoſe two great Circles that croſs each other at Right Angles in the *Poles* of the *World*, and are divided from the *Equinoctial* each way into 90 Degrees, and numbred with numerical Figures from the *Equinoctial* towards either *Pole* with 10, 20, 30, to 90.

Secondly, The *Equinoctial*, which is a Circle lies exactly in the middle between the two *Poles*, and Cuts the *Colures* at Right Angles, as it is alſo Cut by them. It is divided into 360 Degrees numbred from the *Vernal Colure Eaſtwards*, with 10, 20, 30, to 360.

Thirdly, The *Zodiack*, which is a broad Circle that lies Oblique or aſlope from the *Equinoctial*, making an *Angle* of 23½ Degrees with it. It is Cut by the *Equinoctial* and its *Colures* in two Points, *viz.* in ♈ and ♎, and by the *Tropical Colure* in two Points, *viz.* in ♋ and ♑. In the middle of this broad Circle lies the *Ecliptick* Line, which is divided into twelve equal Parts, called *Signs*, as *Aries*, *Taurus*, *Gemini*, &c. to *Piſces*, and ornamented with the Picture of each *Sign*, as to ♈ you have the Picture of a Ram, to ♉ a Bull, and ſo of the reſt. Each *Sign* is again divided into 30 Degrees, and numbred from the beginning of the *Sign* towards the end with 10, 20, to 30. It hath about 5 Degrees of bredth on either ſide the *Ecliptick*, for the Swerving of the *Planets* from the true *Ecliptick* Line.

Fourthly, The two *Tropicks* are ſmaller Circles, commonly made of Wyer, that Decline 23½ Degrees from either ſide the *Equinoctial*, and therefore bound the *Ecliptick*. They Cut the *Colures* at *Right Angles*, as alſo they are Cut by the *Colures*.

Fifthly, The *Arctick* and *Antarctick* Circles, are two Circles yet ſmaller than the *Tropicks*, alſo made of Wyer, that Decline

23½ Degrees from either *Pole:* Theſe alſo Cut the *Colures* at *Right Angles*, as they are alſo Cut by the *Colures*.

This *Machine* is called the *Eighth Heaven*, Becauſe it ſerves to repreſent the *Eighth Heaven:* But its Motion is performed upon its two *Poles*, through which runs a ſtraight Wyer, to repreſent the *Axis* of the *World*, and therefore is called the *Axis:* Next within the *Eighth Heaven*, is placed the *Sphere* or *Heaven* of *Saturn*. It is repreſented by three Circles: Two of them Cut each other at *Right Angles* in their *Poles*, even as the *Colures* do. But for diſtinction from the *Colures* ſhall be called *Upright-Circles* when ever I name them with relation to the *Sphere* of any of the *Planets:* The other Circle Cuts theſe *Upright Circles*, and is alſo Cut by them at *Right Angles* in the middle between their two *Poles:* as the *Equinoctial* does the *Colures:* which Circle I ſhall hereafter call the *Flat Circle*, when I name it with relation to the *Sphere* of any of the *Planets:* on this Circle is writ *Sphera Saturni:* and hard by it is fitted on one of the *Upright Circles*, a *Braſs* plate with a Button on it, which button repreſents the *Star* or *Planet* ♄ it ſelf: it is made to ſlide *Northwards or Southwards* on the *Upright Circle*, becauſe ♄ oft alters its *Latitude* from the *Ecliptick*, and conſequently its *Declination:* And by this means you may ſlide it to any *Latitude*, or *Declination* you ſhall ſee cauſe for.

Next within the *Sphere* of *Saturn*, is placed the *Sphere* of *Jupiter*, which is repreſented by ſuch Circles, and a ſliding Button, even as the *Sphere* of *Saturn* is.

Next within the *Sphere* of ♃, is placed the *Sphere* of ♂, within the *Sphere* of ♂, the *Sphere* of ☉, within the *Sphere* of ☉, the *Sphere* of ♀, within the *Sphere* of ♀, the *Sphere* of ☿, within the *Sphere* of ☿, the *Sphere* of ☾, all repreſented as is the *Sphere* of ♄, and all performing their Motions upon their own *Poles*, and the *Axis* of the *World*.

Within the *Sphere* of ☾, is placed a ſmall *Globe* of the *Earth*, whereon is deſcribed all the Countries of the *Earth*, and the Names of ſo many inſerted, as the Magnitude of that *Globe* is conveniently able to receive.

This Ball is fixed in the middle of all the *Heavens*, and about it, as about a common Center, they all perform their various Motions.

This *Machine*, or *Fabrick*, or *Model* of the Viſible *World*, (which you will) is Hung in a *Braſen Meridian*, as a *Globe* is See § 4. of Chap. 1. Book 1. And this *Meridian* is let into a Wooden *Horizon* as in § 5. of the ſame Chap. and Book.

The *Quadrant of Altitude*, *Hour-Circle*, and its *Index*, *Nautical* Compaſs, and *Semi-Circle of Poſition*, which belong to a *Sphere*, are in all reſpects the ſame with thoſe belonging to a *Globe*, and therefore I refer you to § 6, 7, 8, 9. of the ſame Chapter.

But becauſe all Problemes that have relation to any of the *Planets*, or their *Spheres*, are more aptly and properly performed by the *Sphere* than the *Globe* (becauſe you have a particular *Heaven* aſſigned each particular *Planet*, and by reaſon of the openneſs of every *Sphere* you may ſee the more natural Situation and poſition of them all at once.) Therefore I here produce two Problemes which may ſerve as *Examples* to direct you in all Operations, that you may meet with of this Nature. And firſt,

PROB. V.

To Set the Sphere *and all the* Planets *in a Poſition agreeable to the whole Frame of the Viſible* World, *at any given Time.*

First Rectifie the *Eighth Sphere*, *Horizon*, *Quadrant of Altitude*, and *Hour Index* to your Elected Time. Then by an *Ephemeris* find the true Places of the *Planets* in *Heaven* for that Time: And bring each reſpective *Node* which repreſents each reſpective *Planet*, to thoſe ſeveral Places you find them in the *Ephemeris*; ſo ſhall the *Planets* appear in the *Sphere* juſt in the ſame Place they are in Heaven.

Example.

I would Place the *Planets* on the *Sphere* to Agree with the Places they have at this preſent Tine, *viz.* 1669. *Sep.* 17. juſt at Noon, in the Latitude of 51½ Degrees. Therefore I firſt Rectifie the *Sphere* to the given Time, as by Prob. 2. of the 2d. Book, then in the *Ephemeris* I find the Place of the *Sun* ♎ 4 Degrees 42 Minutes, therefore I bring the little *Golden Node* on the

Suns Orb to ♎ 4 Degrees 42 Minutes, ſo is that little Golden *Node* Placed in the *Sphere* to agree with the Place the *Sun* hath in *Heaven:* then ſearching the *Ephemeris* again for the *Moons* Place, I find She is in ♏ 0 Degrees 36 Min. and hath 10 Minutes *North Latitude* from the *Eclip.* Therefore I bring the little Silvered ☽ in the *Moons Orb*, to ♏ 0 Degrees 36 Min. of the Eighth *Sphere*, and ſlide the Silver ☽ 10 Minutes to the *Northwards* of the *Ecliptick* Line, ſo is that Silvered *Moon* Placed in the *Sphere* to agree with the Place the *Moon* hath in *Heaven.* Then ſearching in the *Ephemeris* for the Place of ♄, I find ♄ in 19 Degrees 19 Minutes of ♒, and hath 1 Deg. 27 Min. *South Latitude* from the *Ecliptick:* Therefore I bring the little *Node* or Ball upon the *Sphere* of ♄, to ♒ 19 Degrees 19 Minutes of the Eighth *Sphere*, and ſlide the Button or *Node* which repreſents ♄ 1 Deg. 27 Min. to the *Southwards* of the *Ecliptick* Line: So is that *Node* or Ball Placed in the *Sphere* to agree with the Place ♄ hath in *Heaven.* The like way I uſe, to Place ♃, ♂, ♀, ☿, in the *Sphere*, to agree with their Places in *Heaven.*

The Eighth *Sphere* and the *Nodes* repreſenting all the *Planets*, being thus poſited, becomes an actual Repreſentation of the whole Frame of the Viſible *World:* And all the *Spheres* of the *Planets* by being turned about with the Eighth *Heaven*, perform a *Diurnal* Mutation, and ſhew all the Various Appearances they will have in *Heaven*, for that Day, *viz.* The Time of their Riſing and Setting, as by Prob. 7, 8. Their *Altitudes* as by Prob. 6. Their *Amplitudes* as by Prob. 10. Their *Azimuths* and *Almicanters* as by Prob. 22, 23. Their *Right Aſcenſions* as by Prob. 26. Their *Declinations* as by Prob. 2. Their *Oblique Aſcenſions* and *Oblique Deſcenſions* as by Prob. 28. Their *Diurnal* and *Nocturnal Arches* as by Prob. 38 of the Second Book: Their Configurations or *Aſpects* among themſelves, and their Circulations about the *Earth*.

PROB. II.

How Eclipſes *are Demonſtrated by the* Sphere.

YOU muſt know that the *Moon* moves not conſtantly in the *Ecliptick*, as the *Sun* does, for if She did, there would two *Eclipſes* happen every Month; the one of the *Sun*, and the other of the *Moon*, but She moves in a

Circle Oblique to the *Eliptick* about 5 Deg. even as the *Ecliptick* is Oblique to the *Equinoctial* 23½ Deg. And as the *Ecliptick* Cuts the *Equinoctial* only in two Oppoſite points, *viz.* ♈ and ♎ So the Circle of the *Moon* Cuts the *Eclip.* only in two Oppoſite Points, which are called, The *Dragons-Head* (thus charactered ☊) and the *Dragons-Tail* (thus charactered ☋) That point which interſects the *Ecliptick* on the *Eaſtern* ſide, and proceeds *Northwards*, is called the *Dragons-Head*; and the Oppoſite Point the *Dragons-Tail.* Theſe Points conſtantly ſhift their Places, and have a *Retrograde* Motion through the *Ecliptick* in almoſt 19 Years: And when the *Sun* and *Moon* meet in or near either of theſe Points, or oppoſe each other in or near theſe Points, an *Eclipſe* happens; if they meet, the *Sun* is *Eclipſed*, becauſe the dark ſolid Body of the *Moon*, interpoſes between our Sight and the *Sun*, and ſo hides him: If they oppoſe each other, the *Moon* is *Eclipſed*, for then the dark ſolid Body of the *Earth*, interpoſes between the *Sun* and the *Moon*, and ſo hinders the Light of the *Sun* from falling upon the *Moon*, which hath no Light of Her own but what She receives from the *Sun*.

But that you may the more plainly ſee the Demonſtration of *Eclipſes* by the *Sphere:* Place the Golden Ball repreſenting the *Sun*, and the *Silvered* ☾ repreſenting the ☾ in two Oppoſite Points of the *Ecliptick*; ſo ſhall the *Sun*, the *Earth*, and the *Moon* be all in a ſtraight Line, and the *Moon Eclipſed*; becauſe the *Earth* lying directly between the *Sun* and the *Moon*, keeps the Light of the *Sun* off the *Moon*, and ſo becomes a Shadow to Her, which of Her ſelf hath no Light but what ſhe receives from the *Sun*, as was ſaid before; and the *Moon* will continue Darkned, till She comes out of the *Earth's* Shadow.

Again, Place the *Sun* and *Moon* in the ſame *Sign* and Deg. of the *Ecliptick*; and imagine as before, a Light to come from the *Sun* in the *Sphere*; then will you ſee the reaſon why the Light of the *Sun* cannot fall upon the *Earth*, *viz.* becauſe the *Moon* is interpoſed betwixt the *Sun* and the *Earth*, and ſo Shadows the *Earth* by keeping the Light of the *Sun* off it, which to us appears as if the *Sun* were Darkned, though indeed it is only the *Earth* that is deprived of the *Sun's* Light by the interpoſition of the *Moon*, as aforeſaid.

But becauſe an *Eclipſe* happens not, as was ſaid before, but when the *Sun* and *Moon* ſeems to meet or oppoſe one another in or near the *Dragons-Head* or *Tail*; therefore by the following Rule you muſt learn to find the Place of the *Dragons-Head* and *Tail*, that ſo by the *Suns* and *Moons* Progreſs through the *Eclipticks*, you may know when the *Sun* and She will Meet or Oppoſe each other in or near thoſe Points, and accordingly fore-know an *Eclipſe*.

How to find the place of the Dragons-Head *and* Tail.

The *Dragons-Head* and *Tail* finiſh a *Retrograde Revolution* through the *Ecliptick* in 18 Years 224 Days and 3 Hours; So that in one Year it moves 19 Deg. and 20 Min. in a Month 1 Deg. 36 Min. and in one Day 3 Min. Therefore if for any Time paſt or to come, you know the Place of the *Dragons-Head* or *Tail* you may Add or Subtract 19 Deg. 20 Min. for every Year, 1 Deg. 36 Min. for every Month, and 3 Min. for every Day, and the Remainder ſhall be the Deg. and Min. that the *Dragons-Head* or *Tail* is in.

Example.

It is to be ſuppoſed that I remember the Place of the *Dragons-Head* to be in ♍ 12 Deg. 20 Min. I would know the Place of the *Dragons-Head* for this preſent Day, *Sept.* 17. 1669. Since *January* 1. 1663. there is 6 Years 8 Months and 17 Days paſt: Therefore for each Year I allow 19 Deg. 20 Min. which makes 116 Deg. for the 8 Months I allow 8 Deg. and 8 times 36 Min. *viz.* 12 Deg. 48 Min. more, which makes 128 Deg. 48 Min. and for the 17 Days I allow 5 Min. which,

116--00
12----48
51 added together, make
129 Deg. 39 Min.

which Subtracted (becauſe the *Dragons-Head* moves contrary to the Succeſſion of *Signs*) from ♍ 12 Deg. 20 Min. leaves ♉ 2 Deg. 41 Min. for the Place of the *Dragons-Head Sept.* 17. 1669. The Place of the *Dragons-Tail*, as was ſaid before, is the Deg. and Min. of the *Ecliptick* Oppoſite to that of the *Dragons-Head*, which in this *Example* is ♏ 2 Deg. 41 Min.

Here follows the

ANCIENT STORIES
Of the ſeveral
STARS and *CONSTELLATIONS*.
Shewing the Poetical Reaſons why ſuch Various
Figures are placed in *HEAVEN*.

Collected from Dr. Hood.

And Firſt,
Of the Northern Conſtellations.

URSA MINOR. This *Conſtellation* hath the Preheminence, becauſe it is neareſt of all the reſt unto the *North Pole*; and is called of the *Greeks Arctos*, whereupon the *Pole* is called the *Pole Artick*, for that it is near unto that *Conſtellation*. It is alſo called *Helice Minor*, becauſe of the ſmall Revolution which it maketh round about the *Pole*: or rather of *Elice*; a Town in *Arcadia*, wherein *Caliſto* the *Great Bear*, and Mother to the leſs, was bred. It is called *Cynoſura*, becauſe this *Conſtellation*, though it carry the name of a *Bear*, yet it hath the Tail of a *Dog*: Laſt of all, it is termed *Phœnice*, becauſe that *Thales*, who firſt gave the name to this *Conſtellation*, was a *Phœnician*: And therefore the *Phœnicians* being taught how to uſe it in their *Navigations*, did call it by the name of the Country wherein *Thales* was born. It conſiſteth of ſeven *Stars*, which the Latines call *Septentriones*; becauſe by their continual Motion thoſe ſeven *Stars* do as it were wear the *Heavens*. The *Spaniards* call them all *Boſina*, that is an *Horn*; becauſe they may be very well brought into that Form; whereof that which is in the end of the Tail, is called the *Pole-ſtar*, by reaſon of the nearneſs thereof unto the *Pole* of of *World*: for it is diſtant (according to the Opinion of moſt) from the true *Pole*, but three Degrees 30 Minutes. The *Arabians* call it *Alrukaba*: And of the *Scythians* it is ſaid to be an *Iron Nail*, and is Worſhipped by them as a God. The two *Stars* that are in the ſhoulders of the *Bear*, are called the *Guards*, of the *Spaniſh* word *Guardare*, which is to behold; becauſe they are diligently to be lookt unto, in regard of their ſinglar Uſe which they have in Navigation.

The reaſon why this *Conſtellation* was brought into the *Heavens* is diverſly ſet down, and firſt in this manner: *Saturn* having received of the Oracle that one of his Sons ſhould baniſh him out of his Kingdom, determined with himſelf to kill all the Men Children that he ſhould beget: whereupon he gave command to *Ops* his wife, being then great, that ſhe ſhould ſhew him the Child ſo ſoon as ever it was born: But ſhe bringing forth *Jupiter*, and being greatly delighted with his hair, gave the Child unto two Nymphs of *Crete*, dweling in the Mount *Dicte*; whereof this was one, and was called *Cynoſura*, the other was *Helice*.

Jupiter after that (according to the Oracle) he had bereft his Father of his Kingdom, in recompence of their pains and courteſie, tranſlated them both into the *Heavens*, and made of them two *Conſtellations*: The *Leſſer Bear*, and the *Greater Bear*.

Otherſome ſay that it was *Arcas* the Son of *Caliſto*, and they tell the Tale on this manner: *Caliſto* a Nymph of ſingular beauty, Daughter to *Lycaon* King of *Arcadia*, induced by the great deſire ſhe had of Hunting, became a follower of the Goddeſs *Diana*. After this, *Jupiter* being Enamored with her Beauty, and out of hope, by reaſon of her Profeſſion, to win her Love in his own Perſon, counterfeited the ſhape of *Diana*, Lay with *Caliſto*, and got her with Child, of whom was born a Son, which was called *Arcas*. *Diana*, or rather *Juno*, being very much offended herewith, turned *Caliſto* into a *Bear*. *Arcas* her Son at the Age of Fifteen, Hunting in the Woods by chance lighted upon his Mother in the ſhape of a *Bear*: Who knowing her Son *Arcas*, ſtood ſtill that he might come near unto her, and not be affraid: But he fearing the ſhape of ſo cruel a Beaſt, bent his Bow of purpoſe to have ſlain her: Whereupon *Jupiter* to prevent the miſchief tranſlated them both into *Heaven*, and of them made two ſeveral *Conſtellations*: Unto the *Leſſer Bear*, there belongs but one Star unformed

2. URSA MAJOR, the *Greater Bear*, called alſo of the *Greeks*, *Arctos*, and *Helice*, conſiſteth of twenty ſeven *Stars*; among the

which, thoſe ſeven that are in the Hinder part and Tail of the *Bear*, are moſt obſerved: the *Latins* call them *Plauſtrum*; and of our Men they are called *Charles Wayn*; becauſe the *Stars* do ſtand in ſuch ſort, that the three which are in the Tail reſemble the Horſes, and the other four which are in the flank of the *Bear*, ſtand (after a manner) like the Wheels of a Wagon, or Chariot; and they are ſuppoſed by ſome to be greater than the *Sun*. The reaſon of the Tranſlation of this *Conſtellation* into the *Heaven*, is at large ſet down in the other *Conſtellation*, and therefore needs not here to be repeated. This *Conſtellation* was firſt invented by *Nauplius*, the Father of *Palamedes* the *Greek*: And in great uſe among the *Grecians*; and this is to be noted both in this and the former *Conſtellation*, *that they never Set under the* Horizon *in any part of* Europe: which tho' it fall out by reaſon of their Situation in the *Heavens*; yet the Poets ſay, that it came to paſs through the diſpleaſure and hatred of *Juno*, who for that ſhe was by *Caliſto* made a Cuckquean, and they notwithſtanding (as ſhe took it) in deſpight of her were tranſlated into *Heaven*, requeſted her Brother *Neptune*, that he ſhould never ſuffer thoſe *Stars* to Set within his Kingdom. To which requeſt *Neptune* condeſcended; ſo that in all *Europe* they never come near unto the Sea, or touch the *Horizon*. If any one marvel, that (ſeeing She hath the form of a *Bear*) She ſhould have a Tail ſo long; Imagine that *Jupiter* fearing to come too nigh unto her Teeth, laid hold on her Tail; and thereby drew her up into *Heaven*; ſo that She of her ſelf being very weighty, and the diſtance from the *Earth* to the *Heaven* very great, there was great likelihood that her Tail muſt ſtretch. The Unformed *Stars* belonging to this *Conſtellation* are eight.

3. DRACO, the *Dragon*, of ſome named the *Serpent*; of others the *Snake*, by the *Arabians*, *Aben*; and by *Junctinus Florentinus*, *Vrago*; becauſe he windeth his Tale round about the *Ecliptick Pole*; it containeth one and thirty *Stars*. This was the *Dragon* that kept the Golden Apples in the Orchard of the *Heſperides*, (and now thought to be the Iſlands of *Cape de Virde*) and for his diligence and watchfulneſs, was afterwards tranſlated into *Heaven*: Yet others ſay that he came into *Heaven* by this occaſion; when *Minerva* withſtood the *Gyants* fighting againſt the *Gods*; they to terrifie her threw at her a mighty *Dragon*; but ſhe catching him in her Hands, threw him preſently up into

Heaven and placed him there, as a Memorial of that her reſiſtance. Others would have it to be the *Serpent Python*, whom *Apollo* ſlew, after the Deluge.

4. CEPHEUS containeth in him eleven *Stars*, and hath two unformed. This was a King of the *Æthiopians*, and Husband unto *Caſſiopeia*, and Father of *Andromeda*, whom *Perſeus* Married, He was taken up into *Heaven*, with his Wife and Daughter, for the good deeds of *Perſeus* his Son in Law; that he and his whole Stock might be had in remembrance for ever. The *Star* which is in his Right Shoulder, is called by the *Arabians* *Alderahiemin* (i. e.) his Right Arm.

5. BOOTES, *the Driver of the Oxen* (for ſo I ſuppoſe the name to ſignifie, rather than an *Herdſman*; for he hath not his name becauſe he hath the care of any Cattel, but only becauſe he is ſuppoſed to drive *Charles his Wayn*, which is drawn by three Oxen) He is alſo called *Arctophilax*, the keeper of the *Bear*, as tho' the care of Her was committed to him: This *Conſtellation* conſiſteth of two and twenty *Stars*. Some will have *Bootes* to be *Arcas*, the Son of her who before was turned into the *Great Bear*; and they tell the Tale thus: *Lycaon* the Father of *Caliſto*, receiving *Jupiter* into his Houſe as a Gueſt, took *Arcas* his Daughters Son, and cut him in pieces; and among other Services, ſet him before *Jupiter* to be eaten: For by this means he thought to prove if his Gueſt were a *God*, as he pretented to be. *Jupiter* perceiving this heinous fact, overthrew the Table, fired the Houſe with Lightning, and turned *Lycaon* into a Wolf: But Gathering, and ſetting together again the Limbs of the Child, he committed him to a Nymph of *Ætolia* to be kept: *Arcas* afterwards coming to Mans Eſtate, and hunting the Woods, lighted at unawares upon his Mother, transform'd by *Juno* into the ſhape of a *Bear*, whom he purſued into the Temple of *Jupiter Liceus*, whereunto by the Law of the *Arcadians*, it was death for any Man to come. For as much therefore as they muſt of likelihood be both ſlain, *Caliſto* by her Son, and he by by the Law; *Jupiter* to avoid this miſchief, of meer pity took them both up into *Heaven*. Unto this *Conſtellation* belongeth but one *Star* unformed, and it is between the Legs of *Bootes*, and by the *Grecians* it is called *Arcturus*, becauſe of all the *Stars* near the Great *Bear* named *Arctos*, this *Star* is firſt ſeen near her Tail in the Evening. The Poetical invention is thus.

Icarus the Father of *Erigone*, having received of the God

Bacchus a Flagon of Wine, to declare how good it was for mortal Men, travelled therewith into the Territories of *Athens*, and there began to Carouſe with certain Shepherds; they being greatly delighted with the pleaſantneſs of the Wine, being a new kind of Liquor, began to draw ſo hard at it, that ere they left off, they were paſt one and thirty; and in the end, were fain to lay their Heads to reſt. but coming unto themſelves again and finding their Brains ſcarce in good temper, they killed *Icarus*, thinking indeed that he had either Poyſoned them, or at the leaſtwiſe made their Brains intoxicated. *Erigone* was ready to die with grief, and ſo was *Mera*, her little Dog. But *Jupiter* to allay their grief, placed her Father in *Heaven*, between the Legs of *Arctophilax*.

6. CORONA BOREA, the *Northern Garland*, conſiſteth of Eight *Stars*; yet *Ovid* ſaith, that it hath Nine. This was the *Garland* that *Venus* gave unto *Ariadne*, when ſhe was Married unto *Bacchus*, in the Iſle *Naxus*, after that *Theſeus* had forſaken her: Which *Garland*, *Bacchus* placed in the *Heaven*, as a token of his Love. *Novidius* will have it to be the *Crown of the Virgin Mary*.

7. ENGONASIS, This *Conſtellation* hath the name, becauſe it is expreſſed under the ſhape of a Man kneeling upon the one Knee, and is therefore by the *Latines* called *Ingeniculum*. It containeth nine and twenty *Stars*, and wanteth a proper Name, becauſe of the great diverſity of Opinions concerning the ſame. For ſome will have it to be *Hercules*, that mighty Conqueror, who for his 12 labours was thought worthy to be placed in *Heaven*, and nigh unto the *Dragon* whom he overcame. Others tell the Tale thus: That when the *Tytans* fought againſt the *Gods*, they for fear of the *Gyants*, ran all unto the oneſide of the *Heaven*: Whereupon the *Heaven* was ready to have fallen, had not *Hercules* together with *Atlas*, ſet his Neck unto it, and ſtaied the fall: And for his deſert, he was placed in *Heaven*.

8. LYRA, the *Harp*, it containeth ten *Stars*; whereof thus goeth the Fable. The River *Nilus* ſwelling above his Banks, overflowed the Country of *Egypt*; after the Fall whereof there were left in the fields divers kinds of living things, and amongſt the reſt a *Tortoiſe*; *Mercury*, after the fleſh thereof was conſumed, the ſinews ſtill remaining, found the ſame, and ſtriking it, he made it yield a certain ſound; whereupon he made an *Harp* like unto it, having three Strings, and gave it unto *Orpheus* the

Son of *Caſſiopea.* This *Harp* was of ſuch excellent Sound, that Trees, Stones, Fowls and wild Beaſts are ſaid to follow the ſound thereof. After ſuch time therefore that *Orpheus* was ſlain by the Women of *Thrace*, the *Muſes* by the good leave of *Jupiter*, and at the requeſt of *Apollo*, placed this *Harp* in *Heaven*. *Novidius* will have it to be the *Harp* of *David*, whereby he pacified the evil ſpirit of *Saul*. This *Conſtellation* was afterwards called *Vultur Cadens*, the *Falling Gripe*: And *Falco* the *Falcon*; or *Timpanum* the *Timbrel*.

9 OLOR, or *Cygnus* the *Swan*, called of the *Chaldæans Adigege*; It hath ſeventeen *Stars*: Of this *Conſtellation* the Poets Fable in this manner. *Jupiter* being overtaken with the Love of *Leda* the Wife of *Tyndarus* King of *Oebilia*, and knowing no honeſter way to accompliſh his deſire, procured *Venus* to turn her ſelf into an *Eagle*, and himſelf he turned into the ſhape of a *Swan*. Flying therefore from the *Eagle*, as from his natural Enemy, that earneſtly purſued him, he lighted of purpoſe in the Lap of *Leda*, and, as it were, for his more ſafety, crept into her Boſome. The Woman not knowing who it was under that ſhape, but holding (as ſhe thought) the *Swan* faſt in her Arms, fell aſleep: In the mean while *Jupiter* enjoyed his Pleaſure; and having obtained that he came for, betook him again unto his Wings; and in memorial of his Purpoſe (attained under that Form) he placed the *Swan* among the *Stars*.

Ovid calleth this *Conſtellation Milvius*, the *Kite*, and telleth the Tale thus. The *Earth* being greatly offended with *Jupiter*, becauſe he had driven *Saturn* his Father out of his Kingdom, brought forth a Monſtrous *Bull*, which in his hinder parts was like a Serpent; and was afterwards called the *Fatal Bull*; becauſe the *Deſtinies* had thus decreed, that whoſoever could ſlay him, and offer up his entrails upon an Altar, ſhould overcome the Eternal Gods. *Briareus* the mighty *Gyant*, and ancient Enemy of the Gods, overcame the *Bull*, and was ready to have offered up his entrails according to the decree of the *Deſtinies*: But *Jupiter* fearing the event, commanded the Fowls of the *Air* to ſnatch them away: Which altho' to their power, they endeavour'd, yet there was none of them found ſo forward and apt to that action as the *Kite*, and for that cauſe he was accordingly rewarded with a Place in *Heaven*. Some call this *Conſtellation Avis*, that is, the *Bird*: Others call it *Vultur Volans*, the *Flying Grype*: It is alſo called *Gallina*, the *Hen*. Unto this *Conſtellation* do belong two unformed *Stars*.

10. CASSIOPEIA, She conſiſteth of thirteen *Stars*. This was the Wife of *Cepheus*, and the Mother of *Andromeda*, whom *Perſeus* married, and for his ſake was tranſlated into *Heaven*, as ſome write. Others ſay that her beauty being ſingular, ſhe waxed ſo proud, that ſhe preferred her ſelf before the *Nereides*, which were the *Nymphs* of the *Sea*: For which cauſe, unto her diſgrace and the example of all others that in Pride of their Hearts would advance themſelves above their betters, ſhe was placed in the *Heaven* with her head as it were downwards; ſo that in the revolution of the *Heavens* ſhe ſeemeth to be carried head-long.

11. PERSEUS, He hath ſix and twenty *Stars*. This was the Son of *Jupiter*, whom he in the likeneſs of a *Golden Shower* begat upon *Danae*, the Daughter of *Acriſius*. This *Perſeus* coming unto Mans Eſtate, and being furniſhed with the Sword, Hat, and Wings of his Brother *Mercury*, and the Shield of his Siſter *Minerva*, was ſent by his Foſter-Father *Polidectes*, to kill the Monſter *Meduſa*, whom he ſlew; and cutting off her Head, carried it away with him: But as he was haſting Homeward, flying in the Air, he eſpied *Andromeda* the Daughter of *Cepheus* and *Caſſiopeia* for the Pride of her Mother, bound with a Chain unto a Rock, by the Sea ſide, there to be devouered by a Whale: *Perſeus* taking notice and Pity of the caſe, undertook to fight with the Monſter, upon condition that *Andromeda* might be his Wife; to be ſhort, he delivered *Andromeda*, Married her, and returning Homeward unto the Iſle *Seriphus*, he found there his Grand-father *Acriſius*, whom by miſchance and unadviſedly he ſlew wit a Quoit: (or as *Ovid* reporteth) with the terrible ſight of the horrible Head of *Meduſa*, not knowing that it was his Grand-father: But afterwards underſtanding whom he had ſlain, he pined away through extream ſorrow: Whereupon *Jupiter* his Father pitying his Grief, took him up into *Heaven*: and there placed him in that form wherein he overcame *Meduſa*, with the Sword in one Hand, and the Head of *Meduſa* in the other, and the Wings of *Mercury* at his Heels. This *Conſtellation* becauſe of the unluckineſs thereof is called by *Aſtrologers Cacodemon* (i.e.) *Unlucky*, and *Unfortunate*. For (as they ſay) they have obſerved it, that whatſoever is Born under this *Conſtellation*, having an evil Aſpect, ſhall be ſtricken with Sword, or loſe his Head. *Novidius* ſaith that it is *David* with *Goliah* his Head in one hand and his Sword in the other. The unformed *Stars* belonging unto this *Conſtellation* are three.

12. AURIGA, the *Waggoner*, or *Carter*: He conſiſteth of fourteen *Stars*: The *Arabians* call him *Alaiot*; the *Greeks Henniochus*, (*i. e*) a Man holding a Bridle in his hand, and ſo is he Pictured. *Eratoſtanes* affirmeth him to be *Ericthonius* King of *Athens*, the Son of *Vulcan*, who having moſt deformed Feet, deviſed firſt the uſe of the *Waggon* or *Chariot*, and joined Horſes together to draw the ſame, to the end that he ſitting therein, might the better conceal his Deformities. For which invention, *Jupiter*, tranſlated him into the *Heavens*.

In this *Conſtellation* there are two other particular *Conſtellations* to be noted; whereof the one conſiſteth but of one *Star* alone, which is in the left Shoulder of *Auriga*, and is called *Hircus*, or *Capra* the *Goat*; the *Arabians* call it *Alhajoth*: The other conſiſteth of two little *Stars* a little beneath the other, ſtanding as it were in the hand of *Auriga*; this *Conſtellation* is called *Hædi*, the *Kids*. The Tale is thus; *Saturn* (as you heard before) had received of the Oracle, that one of his Sons ſhould put him out of his Kingdom, whereupon he determined to devour them all: *Ops* by ſtealth conveyed away *Jupiter*, and ſent him to *Meliſſus* King of *Crete*, to be Nouriſhed. *Meliſſus* having two Daughters, *Amalthæa* and *Meliſſa*, committed *Jupiter* unto their Nurſery; *Amalthæa* had a *Goat* that gave Suck unto two *Kids*, ſo that by the Milk of this *Goat*, ſhe Nouriſhed *Jupiter* very well. To requite this her care and courteſie, *Jupiter* after he had put his Father out of his Kingdom) tranſlated her *Goat* and her two *Kids* into *Heaven*; and in remembrance of the Nurſe, the *Goat* is called *Capra Amalthæa*. *Novidius* ſaith, that when Chriſt was born, and his Birth made manifeſt by the Angels unto the Sheperds, one of them brought with him for a Preſent, a *Goat* and two young *Kids*; which in token of his good will, were placed in *Heaven*.

13. OPHIUCHUS, or SERPENTARIUS, That is, the *Serpent-bearer*. This *Conſtellation* hath no proper name, but is thus entituled becauſe he holdeth a *Serpent* in his hands. It containeth four and twenty *Stars*. Some ſay that it is *Hercules*, and report the Tale on this manner. *Juno* being a great enemy to *Hercules*, ſent two Snakes to kill him as he lay ſleeping in his Cradle: but *Hercules* being a luſty Child(for *Jupiter* had ſpent two days in begetting him) without much ado ſtrangled them both: In memorial of ſo ſtrange an event, *Jupiter* placed him in the *Heavens*, with a *Serpent* in his hands.

14. SERPENS, the *Serpent* of *Ophiuchus*, which conſiſteth of eighteen *Stars*. Some ſay that it is one of the Serpents that ſhould have ſlain *Hercules* in his Cradle. *Novidius* ſaith, it is the *Viper* that bit *Paul* by the hand. Others deliver the Tale in theſe words: *Glaucus* the Son of *Minos* King of *Crete*, was by misfortune drowned in a Barrel of Honey: *Minos* his father craved the help of *Æſculapius* the Phyſician: And that he might be driven perforce to help the Child, he ſhut him up in a ſecret place, together with the dead Carcaſs: Whiles *Æſculapius* ſtood in a great maze with himſelf what were beſt to be done, upon a ſudden there came a Serpent creeping towards him; the which Serpent he ſlew with the ſtaff which he had in his hand. After this there came another Serpent in, bringing in his mouth a certain herb, which he laid upon the head of the dead Serpent, whereby he reſtored him unto Life again. *Æſculapius* uſing the ſame herb, wrought the ſame effect upon *Glaucus*. Whereupon (after that) *Æſculapius* (whom ſome affirm to be *Ophiuchus*) was placed in the *Heaven*, and the Serpent with him.

15. SAGITTA, or *Telum*; the *Arrow* or *Dart*. This was that Arrow wherewith *Hercules* ſlew the *Eagle* or *Grype* that fed upon the Liver of *Prometheus*, being tyed with chains to the top of the Mount *Caucaſus*, and in memorial of that deed, was tranſlated into *Heaven*. Others will have it to be one of thoſe Arrows which *Hercules* at his death gave unto *Phyloctetes*, upon which the Deſtiny of *Troy* did depend. The whole *Conſtellation* containeth five *Stars*.

16. AQUILA, the *Eagle*, which is called *Vultur Volans*, the *Flying Grype*: It hath in it nine *Stars*. The Poetical reaſon of this *Conſtellation*, is this; *Jupiter* transforming himſelf into the form of an *Eagle* took *Ganimedes* the *Trojan Boy*, whom he greatly loved up into *Heaven*, and therefore in ſign thereof (becauſe by that means he performed his purpoſe) he placed the figure of the *Eagle* in the *Heaven*. There belong unto this *Conſtellation* ſix *Stars* (before time) unformed, but now brought into the *Conſtellation* of *Antinous*. But whereupon that name ſhould come, I know not, except it were that ſome Man deviſed it there to curry favour with the Emperour *Adrian*, who loved one *Antinous Bithynicus* ſo well, that he builded a Temple in his Honour at *Mantinea*.

17. DELPHINUS, the *Dolphin*: It containeth ten *Stars* yet;

yet *Ovid* in his Second Book *de Faſtis*, ſaith that it hath but nine. Neither did the Ancient *Aſtronomers* attribute unto it any more, according to the number of the *Muſes*; becauſe of all other Fiſhes the *Dolphin* is ſaid to be delighted with Muſick. The Tale goeth thus concerning this *Conſtellation*. When *Neptune* the God of the *Sea* greatly deſired to Match with *Amphitrite*, ſhe being very modeſt and ſhame-faced, hid her ſelf: whereupon he ſent many Meſſengers to ſeek her out, among whom the *Dolphin* by his good hap, did firſt find her; and perſwaded her alſo to match with *Neptune*: For which his good and truſty Service, *Neptune* placed him in the *Heavens*.

Others ſay, that when *Bacchus* had transformed the Mariners that would have betrayed him, into *Dolphins*, he placed one of them in *Heaven*, that it might be a Leſſon for others to take heed how they carried any one out of his Way, contrary both to his deſire, and their own promiſe. *Novidius* referreth this *Conſtellation* unto the Fiſh that ſaved *Jonas* from drowning.

18. EQUICULUS, is the *Little Horſe*, and it conſiſteth of four *Stars*. This *Conſtellation* is named almoſt of no Writer, ſaving *Ptolomeus*, and *Alphonſus* who followeth *Ptolomy*, and therefore no certain Tale or Hiſtory is delivered thereof, by what means he came into *Heaven*.

19. EQUUS ALATUS, the *Winged Horſe*, or *Pegaſus*, it containeth twenty *Stars*. This *Horſe* was bred of the blood of *Meduſa*, after that *Perſeus* had cut off her Head, and was afterwards taken and tamed by *Bellerophon*, whiles he drank of the River *Pirene* by *Corinth*, and was uſed by him in the conqueſt of *Chimera*: After which Exploit *Bellerophon*, being weary of the Earthly affairs, endeavoured to fly up into *Heaven*. But being amazed in his Flight, by looking down to the *Earth*, he fell from his *Horſe*; *Pegaſus* notwithſtanding continuing his Courſe (as they feign) entered into *Heaven*, and there obtained a Place among the other *Conſtellations*.

20. ANDROMEDA, ſhe conſiſteth of three and twenty *Stars*; but one of them is common both unto her and *Pegaſus*. This was the Daughter of *Cepheus* and *Caſſiopea*, and the Wife of *Perſeus*; the reaſon why *Minerva*, or *Jupiter* placed her in the *Heavens*, is before expreſſed. *Novidius* referreth this *Conſtellation* unto *Alexandria* the *Virgin*, whom S. *George* through the good help of his Horſe delivered from the *Dragon*.

21 TRIANGULUM, the *Triangle*, called alſo *Deltoton*, becauſe it is like the fourth Letter of the Greek Alphabet △, which they call *Delta*; it conſiſteth of four *Stars*. They ſay it was Placed in *Heaven* by *Mercury*, that thereby the head of the *Ram* might be the better known. Others ſay, that it was placed there in Honour of the *Geometricians*, among whom, the *Triangle* is of no ſmall Importance. Others affirm, that *Ceres* in times paſt requeſted *Jupiter* that there might be placed in *Heaven* ſome Figure repreſenting the form of *Sicily*, an *Iſland* greatly beloved of *Ceres*, for the Fruitfulneſs thereof: Now this Iſland being Triangular (at her requeſt) was repreſented in the *Heaven* under that Form.

Thus much concerning the Conſtellations *of the* Northern Hemiſphere. *Now follow the* Poetical Stories *of the* Conſtellation *of the* Southern Hemiſphere.

Secondly.

Of the Southern Conſtellations.

1. CETUS, the *Whale*, It is alſo called the *Lyon*, or *Bear* of the *Sea*. This is that monſtrous Fiſh that ſhould have devoured *Andromeda*, but being overcome by *Perſeus*, was afterwards tranſlated into *Heaven* by *Jupiter*, as well for a Token of *Perſeus* his Manhood, as for the Hugeneſs of the Fiſh it ſelf. This *Conſtellation* conſiſteth of two and twenty *Stars*.

2. ORION, this hath eight and thirty *Stars*. The Poetical reaſon of his tranſlation into the *Heavens*, ſhall be ſhewn in the *Scorpion*, amongſt the *Zodiatical Conſtellations*. The Ancient *Romans* called this *Conſtellatian Jugala*, becauſe it is moſt peſtiferous unto Cattel,and as it were the very Cut-throat of them. There are bright *Stars* in his *Girdle*, which we commonly call our *Ladies yard*,or *Wand*. *Novidius*, applying this Sword of *Orion* unto Scripture, will have it to be the Sword of *Saul* afterwards called *Paul*, wherewith he perſecuted the Members of Chriſt: Which after his Converſion was placed in *Heaven*. In his *Left Shoulder* there is a very Bright *Star*, which in *Latine* is called *Bellatrix* the *Warriour*, in the Fœminine gender. I cannot find the reaſon except it be this; that Women born under

this *Conſtellation* ſhall have mighty Tongues: The reaſon of the *Ox-hide* which he hath in his Hand may be gathered out of the next Story.

3. FLUVIUS, the *River*; it comprehendeth thirty four *Stars*. It is called by ſome *Eridanus*, or *Padus*; and they ſay that it was placed in *Heaven* in Remembrance of *Phaeton*, who having ſet the whole World on Fire by reaſon of miſguiding of his Father *Phœbus* his Chariot, was ſlain by *Jupiter* with a Thunderbolt, and tumbling down from *Heaven*, fell into the River *Eridanus*, or *Padus* which the *Italians* call *Po*. Others ſay that it is *Nylus*, and that that Figure was placed in *Heaven* becauſe of the Excellency of that River, which by the Divines is called *Gihon*; and is one of the *Rivers* of *Paradice*. Others call it *Flumen Orionis* the Flood of *Orion*; and ſay that it was placed there, to betoken the Off-ſpring from whence *Orion* came: For the Tale is thus reported of him.

Jupiter, *Neptune*, and *Mercury*, travelling upon the Earth in the likeneſs of Men, were requeſted by *Hyreus* to take a Poor Lodging at his Houſe for a Night: They being overtaken with the Evening, yielded unto his requeſt; *Hyreus* made them good Cheer; killing an *Ox* for their better Entertainment: The Gods ſeeing the good heart of the Old Man, willed him to demand what he would in recompence of his ſo friendly Cheer. *Hyreus* and his Wife being old, requeſted the Gods to gratifie them with a Son. They to fulfil his deſire, called for the Hide of the *Ox* that was ſlain, and having received it, they put it into the *Earth*, and made water into it all three together, and covering it, willed *Hyreus* within ten Months after to dig it out of the *Earth* again; which he did, and found therein a Man child, whom he called *Ourion*, *ab Urina*, of Piſs; altho' afterwards by leaving out the ſecond Letter, he was named *Orion*. At ſuch time therefore as he was Placed in *Heaven*, this *Flood* was joined hard to his heels, and the *Ox-hide* wherein the Gods did Piſs, was ſet on his left Hand, in memorial of his Off-ſpring.

4. LEPUS, the *Hare*, which conſiſteth of twelve *Stars*. This *Conſtellation* was placed in *Heaven* between the Legs of *Orion*, to ſignifie the great delight in Hunting which he had in his Life time: But others think it was a frivolous thing, to ſay that ſo notable a Fellow as *Orion* would trouble himſelf with ſo ſmall and timorous a Beaſt as the *Hare*: And therefore they tell the Tale thus.

In times paſt there was not a *Hare* left in the Iſle *Leros*: A certain Youth therefore of that Iſland, being very deſirous of that kind of Beaſt, brought with him from another Country thereabout, an *Hare* great with Young; which when ſhe had brought forth, they in time became ſo acceptable unto the other Country-men, that every one almoſt deſired to have and keep a *Hare*, By reaſon whereof, the number of them grew to be ſo great, within a ſhort ſpace after, that the whole Iſland became full of Hares, ſo that their Maſters were not able to find them Meat: Where upon the Hares breaking forth into the Fields, devoured their Corn. Wherefore the Inhabitants being bitten with hunger, joined together with one conſent, and (and tho' with much a do) deſtroyed the Hares. *Jupiter* therefore Placed this *Conſtellation* in the *Heavens*; as well to expreſs the exceeding fearfulneſs of the Beaſt, as alſo to teach Men this leſſon; that there is nothing ſo much to be deſired in this Life, but that at one time or another it bringeth with it more grief than pleaſure. Some ſay, that it was placed in *Heaven* at the requeſt of *Ganimedes*, who was greatly delighted with hunting the Hare.

5. CANIS MAJOR, the *Great Dog*, it conſiſteth of eighteen *Stars*. It is called *Syrius Canis*, becauſe he cauſeth a mighty Drought by reaſon of his Heat. This is the *Conſtellation* that giveth the name unto the *Canicular* or *Dog Days*; whoſe begining and end is not alike in all Places, but hath a difference according to the Country and Time: As in the time of *Hippocrates* the Phyſitian, who lived before the Time of Chriſt 400 Years, the *Canicular Days* began the 13, or 14 of *July*. In the Time of *Avicenna*, the *Spaniard*, who lived in the Year of our Lord 1100. the *Canicular Days* began the 15, 16, or 17. of *July*. In our Country, they being about St. *James-tide*, but we uſe to account them from the 6 of *July*, to the 17 of *Auguſt*; which is the time when the *Sun* beginneth to come near unto, and to depart from this *Conſtellation*.

Novidius will have it to be referred to *Tobias* Dog; which may very well be, becauſe he hath a Tail, *Tobias* Dog had one, as a certain fellow once concluded: Becauſe it is written that *Tobias* his Dog fawned upon his Maſter, therefore it is to be noted (ſaid he) that he had a Tail. The Poets ſay, that this is the Dog whom *Jupiter* ſet to keep *Europa*, after that he had ſtolen her away, and conveyed her into *Crete*, and for his good ſervice was placed in *Heaven*. Others ſay, that it was one of *Orion* his Dogs. There belong unto this *Conſtellation* 11 *Stars* unformed.

6. CANIS MINOR, the *Leſſer Dog*; this of the *Greeks* is called *Procyon*, of the *Latins Ante Canis*; it containeth but two *Stars*. Some ſay, that this was alſo one of *Orions* Dogs. Others rather affirm it to be *Mera* the Dog of *Origone*, or rather of *Icarius* her Father, of whom mention is made in the *Conſtellation* of *Bootes*, and *Virgo*. This Dog of meer love to his Maſter, being ſlain, as aforeſaid, threw himſelf into the River *Anigrus*, but was afterward tranſlated into *Heaven*, with *Origone*. Among the Poets there is great diſſention which of the two ſhould be the Dog of *Origone*; ſome ſaying one, and ſome the other, and therefore they do many times take the one for the other.

7. ARGO NAVIS, the *Ship Argo*, which comprehendeth one and forty *Stars*; this is the *Ship* wherein *Jaſon* did fetch the Golden Fleece from *Colchis*, which was afterward placed in *Heaven* as a Memorial, not only becauſe of the great Voyage, but alſo, becauſe (as ſome will have it) it was the firſt *Ship* wherein any Man Sailed. Their reaſon why this *Ship* is not made whole is, that thereby Men might be put in mind not to deſpair, albeit that their *Ship* miſcarry in ſome part now and then. Some avouch it to be the *Ark* of *Noah*. *Novidius* ſaith, it is the *Ship* wherein the *Apoſtles* were, when *Chriſt* appeared unto them Walking on the *Sea*. In one of the *Oars* of this *Ship*, there is a great *Star*, called *Canopus*, or *Canebus*, which the *Arabians* called *Shuel*, as it were a Bon-fire, becauſe of the greatneſs thereof. It is not ſeen in *Italy*, nor in any Country on this ſide of *Italy*: Some ſay that *Canobus* the Maſter of *Menelaus* his *Ship* was transformed into this *Star*.

8. HYDRA, the *Hydre*; that hath five and Twenty *Stars*, and two unformed.

9. CRATER, the *Cup* or *Standing piece*; that hath ſeven *Stars*, ſome ſay that this was the *Cup* wherein *Tagathon*, that is the chief God, mingled the ſtuff whereof he made the Souls of Men.

10. CORVUS, the *Crow*; this hath ſeven *Stars*. Theſe three *Conſtellations* are to be joined together, becauſe they depend upon one Hiſtory, which is this. On a time *Apollo* made a ſolemn Feaſt to *Jupiter*, and wanting water to ſerve his turn, he delivered a *Cup* to the *Crow* (the Bird wherein he chiefly delighted) and

ſent him to fetch Water therein. The *Crow* flying towards the *River*, eſpied a Fig-tree, fell in hand with the Figs, and abode there till they were Ripe: In the end, when he had fed his fill of them, and had ſatisfied his Longing, he bethought himſelf of his Errand, and by reaſon of his long delay, fearing a check, he caught up a *Snake* in his Bill, brought it to *Apollo*, and told him that the *Snake* would not let him fill the *Cup* with Water. *Apollo* ſeeing the impudence of the Bird, gave him this gift, that as long as the Figs were not ripe upon the Tree, ſo long he ſhould never Drink: And for a memorial of the ſilly excuſe that he made, he placed both the *Crow*, *Cup*, and *Snake* in *Heaven*.

11. CENTAURUS, the *Centaur*, which comprehendeth ſeven and thirty *Stars*. Some ſay that this is *Typhon*, others call him *Chiron*, the Schoolmaſter of thoſe three excellent Men, *Hercules*, *Achilles*, and *Eſculapius*; unto *Hercules* he read *Aſtronomy*, he trained up *Achilles* in *Muſick*, and *Eſculapius* in *Phyſick*: And for his upright Life he was turned into this *Conſtellation*. Yet *Virgil* calleth *Sagittarius* by the name of *Chiron*. In the *hinder Feet* of this *Conſtellation*, thoſe *Stars* are ſet which are called the *Croſiers*, appearing to the *Mariners* as they Sail towards the *South Sea*, in the form of a *Croſs*, whereupon they have their name. The four *Stars* which are in the *Garniſh* of the *Centaurs Spear*, are accounted by *Proclus* as a peculiar *Conſtellation*, and are called by him *Thyrſilochus*, which was a *Spear* compaſſed about with Vine Leaves: But they are called by *Copernicus* and *Clavius*, and other *Aſtronomers*, the *Stars* of his *Target*. It ſhould ſeem that they were deceived by the old Tranſlation of *Ptolomy*, wherein *Scutum* is put for *Haſta* (*i.e.*) the *Target*, for the *Spear*, as it is well noted by our Country-man M. *R. Record*, in his Book Intituled, *The Caſtle of Knowledge*.

12. LUPUS, the *Wolf*, or the Beaſt which the *Centaur* holdeth in his Hand, containeth nineteen *Stars*, the Poetical reaſon is this, *Chiron* the *Centaur* being a juſt Man, was greatly given to the Worſhip of the Gods: For which thing, that it might be notified to all Poſterity, they placed him by this Beaſt, which he ſeemeth to ſtick and thruſt through with his *Spear* (as it were) ready to kill for Sacrifice.

13. ARA, the *Altar*, it is alſo called *Lar*, or *Thuribulum*, (*i.e.*) a Chimney with the Fire, or a Cenſor. It conſiſteth of ſeven *Stars*, and is affirmed of ſome Poets, to be the *Altar* where-

on the *Centaur* was wont to offer up his Sacrifice. But others tell the Tale thus. When as the great Gyants, called the *Tytans*, laboured as much as might be to pull *Jupiter* out of *Heaven*, the Gods thought it good to lay their heads together, to adviſe what was beſt to be done: Their concluſion was, that they ſhould all with one conſent join hands together to keep out ſuch fellows; and that this their League might be confirmed, and throughly ratified, they cauſed the *Cyclops* (which were Workmen of *Vulcan*) to make them an *Altar*: About this *Altar* all the Gods aſſembled, and there ſwore, that with one conſent they would withſtand their Enemies; afterwards, having gotten the Victory, it pleaſed them to place this *Altar* in *Heaven*, as a Memorial of their League, and a token of that good which unity doth breed.

14. CORONA AUSTRINA, the *South Garland*, it hath 13 *Stars*. Some ſay that it is ſome trifling *Garland* which *Sagittarius* was wont to wear, but he caſt it away from him in jeſt, and therefore it was placed between his Legs: Others call it the Wheel of *Ixion*, whereupon he was Tormented for that great diſcourteſie he would have offered unto *Juno*, thinking indeed to have gotten up her Belly: But *Jupiter* ſeeing the impudency of the Man, tumbled him out of *Heaven* (where by the Licence of the Gods, he was ſome time admitted as a gueſt) into *Hell*, there to be continually Tormented upon a *Wheel*. The Figure of which *Wheel* was afterwards placed in *Heaven*, to teach Men to take heed how they be too ſaucie to make ſuch courteous proffers unto other Mens Wives. The *Greeks* call this *Conſtellation* by the name of *Vraniſcus*, becauſe of the Figure thereof: For it repreſenteth the Palate or Roof of the mouth, which they call *Vraniſcus*.

15. The laſt is PISCIS AUSTRINUS, or *Notius*, the *South Fiſh*, which comprehendeth eleven *Stars*, beſides that which is in the Mouth thereof, belonging to the *Water*, which runneth from *Aquarius*, and is called by the *Arabians Fomahant*. The reaſon why this *Fiſh* was placed in the *Heaven*, is uncertain: Yet ſome affirm, that the Daughter of *Venus* going into a Water to Waſh herſelf, was ſuddenly transformed into a *Fiſh*, the which *Fiſh* was afterwards tranſlated into *Heaven*. The unformed *Stars* belonging unto this *Conſtellation* are ſix.

Thus much concerning the Conſtellation *of the* Northern *and* Southern Hemiſpheres; *now follow the* Poetical Stories *of the* Zodiatical *Conſtellations*.

Thirdly.

Of the Zodaical Conſtellations.

1. ARIES, the *Ram*, is called by the *Greeks Crios*; it containeth in it thirteen *Stars*, which were brought unto this *Conſtellation* by *Thyeſtes*, the Son of *Pelops*, and Brother of *Acreus*. This is the *Ram* upon which *Prixus*, and *Helle* his Siſter, the Children of *Athamas* did ſit, when they fled from their Stepmother *Ino*, over the *Sea* of *Helleſpont*: Which *Ram* was afterwards for his good Service, tranſlated into *Heaven* by *Jupiter*. Others ſay that it was that *Ram* which brought *Bacchus* unto the Spring of *Water*, when through Drought he was likely to have Periſhed in the Deſert of *Lybia*. *Novidius* will have this to be the *Ram* which *Abraham* Offered up inſtead of his Son *Iſaac*. The *Star* that is firſt in the Head of the *Ram*, is that from whence our later *Aſtronomers* do account the *Longitude* of all the reſt, and it is diſtant from the Head of *Aries*, in the tenth *Sphere*, 27 Degrees 53 Minutes. The unformed *Stars* belonging unto this *Conſtellation*, are five.

2. TAURUS, the *Bull*, which conſiſteth of twenty three *Stars*. This was tranſlated into *Heaven*, in Memorial of the Rape committed by *Jupiter* on *Europa* the Daughter of *Agenor*, King of *Sidon*; whom *Jupiter* in the likeneſs of a White *Bull* ſtole away, and tranſported into *Candia*. Others ſay, that it was *Io* the Daughter of *Inacus*: Whom *Jupiter* loved, and turned into the form of a *Cow*, to the intent that *Juno* coming at unwares, ſhould not perceive what part he had played: *Jupiter* afterward in memorial of that crafty conveyance, placed that Figure in *Heaven*; The reaſon why the Poets name not certainly whether it be a *Cow* or a *Bull*, is becauſe it wanteth the hinder Parts; yet of the moſt of them it is called a *Bull*. In the Neck of the *Bull* there are certain *Stars*, ſtanding together in a Cluſter, which are commonly called the *Seven Stars*: Although there can hardly be diſcerned any more than ſix. Theſe are reported to be the ſeven Daughters of *Atlas*, called *Atlantiades*, whereof ſix had company with the Immortal Gods, but the ſeventh (whoſe name was *Merope*) being married unto *Syſiphus* a Mortal Man, did

therefore withdraw and hide her Self, as being aſhamed that ſhe was not ſo fortunate in matching herſelf as her Siſters were. Some ſay, that that *Star* which is wanting is *Electra*, the eldeſt Daughter of *Atlas*, and that therefore it is ſo dim, becauſe ſhe could not abide to behold the deſtruction of *Troy*; but at that time and ever ſince, ſhe hid her face. The reaſon why they were taken up into *Heaven*, was, their great pity towards their Father, whoſe miſhap they bewailed with continual Tears. Others ſay, that whereas they had vowed perpetual Virginity, and were in danger to loſe it, by reaſon of *Orion*, who greatly aſſailed them, being overtaken with their Love; they requeſted *Jupiter* to ſtand their Friend, who tranſlated them into *Stars*, and placed them in that part of *Heaven*. The Poets call them *Pleiades*, becauſe when they riſe with the *Sun*, the Mariners may commit themſelves to the *Sea*. Others will have them to be ſo termed *a Pluendo*; becauſe they procure Rain. Others give them this Name, of the *Greek* word *Cleiones*, becauſe they be many in number. They be alſo called *Vigiliæ*, becauſe they riſe with the *Sun* in the *Spring time*: Likewiſe *Athoraiæ*, becauſe they ſtand ſo thick together. Our Men call them by the Name of the *Seven Stars*, or *Brood Hen*. The *Aſtronomers* note this as a ſpecial thing concerning theſe *Stars*, that when the *Moon* and theſe *Stars* do meet together, the eyes are not to be medled withal, or cured if they be ſore: their reaſon is, becauſe they be of the Nature of *Mars* and the *Moon*.

Moreover, there be five *Stars* in the *Face* of the *Bull*, repreſenting the form of the *Roman* Letter V, whereof one (which is the greateſt) is called the *Bull's Eye*. They be called *Hyades*, and were alſo the Daughters of *Atlas*, who ſo long bewailed the death of *Hyas* their Brother, ſlain by a *Lyon*, that they died for ſorrow, and were afterwards placed in *Heaven*, for a Memorial of that great Love they bore to their Brother. The Ancient *Romans* call the *Bull's Eye Parilicium*, or *Palelicium*, of *Pales* their Goddeſs; whoſe Feaſt they Celebrated after the Conjunction of this *Star* and the *Sun*. The unformed *Stars* belonging unto this *Conſtellation*, are eleven.

3. GEMINI, the *Twins*; It conſiſteth of eighteen *Stars*. The Poets ſay, they are *Caſtor* and *Pollux*, the Sons of *Leda*, brethren moſt loving, whom therefore *Jupiter* tranſlated into *Heaven*. Some ſay that the one of them is *Apollo*, and the other *Hercu-*

les: but the moſt affirm the former. The unformed *Stars* of this *Conſtellation* are ſeven, whereof one is called *Tropus*, becauſe it is placed next before the *Foot* of *Caſtor*.

4. CANCER, the *Crab*, it hath nine *Stars*. This is that *Crab* which bit *Hercules* by the Heel as he fought with the Serpent *Hydra* in the Fen *Lerna*, and for his forward Service, was placed in Heaven by *Juno*, the utter Enemy of *Hercules*. In this *Conſtellation* there are *Stars* much ſpoken of by the Poets, although they be but ſmall; whereof one is called the *Crib*, other two are the two *Aſſes*, whereof one was the *Aſs* of *Bacchus*, the other of *Vulcan*, whereon they rode to Battel, when as the Gyants made War with the Gods; with whoſe Braying and ſtrange Noiſe, the Gyants were ſo ſcared upon the ſudden, that they forſook the Field, and Fled. The Gods getting the Victory, in triumphing manner tranſlated both the *Aſſes*, and their *Manger* into *Heaven*. The unformed *Stars* of this *Conſtellation* are four. It is called *Animal Retrogradum*, for when the *Sun* cometh into this *Sign*, he maketh *Retrogradation*.

5. LEO, the *Lyon*; it hath 27 *Stars*, this is that *Lyon* which *Hercules* overcame in the Wood of *Nemaa* and was placed in *Heaven* in remembrance of ſo notable a Deed. *Novidius* ſaith, this was one of the *Lyons* which were in the Den into which *Daniel* was caſt, and was therefore placed in Heaven, becauſe of all other he was moſt friendly unto *Daniel*. In the *Breſt* of this *Conſtellation* is that notable great *Star*, the light whereof is ſuch, as that therefore it is called by *Aſtronomers Bazileus* or *Regulus* (*i.e.*) the *Viceroy*, or little King among the reſt. The unformed *Stars* belonging to the *Lyon* are eight; whereof three make the *Conſtellation* which is now called *Coma Berenices*, that is, the hair of *Berenice*. This *Conſtellation* was firſt found out and invented by *Canon* the *Mathematitian*, but deſcribed by *Calimachus* the Poet. The occaſion of the ſtory was this. *Ptolomeus Eurgetes* having married his Siſter *Berenice*, was ſhortly after enforced to depart from her, by reaſon of the Wars he had begun in *Aſia*: Whereupon *Berenice* made this Vow, that if he returned home again in ſafety, ſhe would offer up her hair in *Venus* Temple. *Ptolomy* returned ſafe; and *Berenice*, according to her Vow, cut off her hair and hung it up. After certain days, the hair was not to be found; whereupon *Ptolomy* the King was greatly diſpleaſed. But *Canon*, to pleaſe the humor of the King, and to

curry favour with him, perſwaded him that *Venus* had conveyed the Hair into *Heaven*. *Canon* attributeth ſeven *Stars* unto it, but *Ptolomy* alotteth it but three, becauſe the other be inviſible.

6. VIRGO, the *Virgin*, it hath twenty ſix *Stars*. This is affirmed to be Juſtice, which among all the Gods ſometime living upon the *Earth*, did laſt of all forſake the ſame, becauſe of the Wickedneſs that began to multiply therein, and choſe this Place for her Seat in Heaven.

Others ſay, that it was *Aſtrea*, the Daghter of *Aſtreus*, one of the Gyants that were called *Titans*, who fighting againſt the Gods, *Aſtrea* took their parts againſt her own Father, and was therefore after her death commended unto the Heavens, and made one of the Twelve *Signs*.

Others ſay, that it was *Erigone*, the Daughter of *Icarius*, who for that her Father was ſlain by certain Drunken men, for very Grief thereof hanged her ſelf: But *Jupiter* taking pity of the *Virgin* for her natural affection, traſlated her into Heaven.

In her *Right Wing* there is one *Star* of ſpecial note, which by the *Aſtronomers* is called *Vindemiator* (*i.e.*) the gatherer of Grapes. This was *Ampelos* the Son of a Satyr and a Nymph, and greatly beloved of *Bacchus*, unto whom in token of his love *Bacchus* gave a ſingular fair Vine, planted at the Foot of an Elm (as the manner was in old time.) But *Ampelos* in Harveſt gathering Grapes, and taking little heed to his footing, fell down out of the Vine, and brake his neck. *Bacchus*, in Memorial of his former affection, tranſlated him into Heaven, and made him one of the principal *Stars* in this *Conſtellation*. There is another great *Star* in the hand of the *Virgin*, called of the *Latins Spica*, of the *Greeks Stachus*, of the *Arabians Azimech* (*i.e.*) the *Ear of Corn*: Whereby they ſignifie, that when the *Sun* cometh to this *Sign*, the Corn waxeth Ripe. *Albumazer* the *Arabian*, and *Novidius*, take this *Conſtellation* for the Virgin *Mary*. The unformed *Stars* in this *Conſtellation* are ſix.

7. LIBRA, the *Ballance*, it containeth 8 *Stars*; *Cicero* calleth it *Jugum* the *Yoak*, and here it is to be noted, that the ancient *Aſtronomers* that firſt ſet down the number of the *Conſtellations* contained in the *Zodiack*, did account but eleven therein, ſo that the *Sign* which now is called *Libra*, was heretofore called *Chelai*, that is to ſay, the *Claws of the Scorpion*, which poſſeſſeth the ſpace of two whole *Signs*. But the later *Aſtronomers*, being de-

ſirous to have Twelve *Signs* in the *Zodiack*, called thoſe eight whereof the *Claws of the Scorpion* do conſiſt, by the Name of *Libra*, not that there was any Poetical Fiction to induce them thereto, but only moved by this reaſon, becauſe the *Sun* joyning with this *Conſtellation*, the Day and the Night are of an equal Length, and are (as it were) equally Poized in a pair of *Ballance*. Yet (as I remember) ſome will have this to be the *Ballance* wherein Juſtice, called alſo *Aſtraa* weighed the Deeds of Mortal Men, and therein preſented them unto *Jupiter*. It hath nine unformed *Stars* appertaining unto it.

8. SCORPIO, the *Scorpion*; called of the *Arabians*, *Alatrab*; of *Cicero*, *Nepa*. It conſiſteth of twenty one *Stars*. The Fiction is thus; *Orion* the Son of *Hyreus* greatly beloved of *Diana*, was wont to make his boaſt, that he was able to overcome what Beaſt ſoever was bred upon the *Earth*: The *Earth* being moved with this ſpeech brought forth the *Sorpion*, whereby *Orion* was ſtung to death. *Jupiter* thereupon at the requeſt of the *Earth*) tranſlated both the *Scorpion* and *Orion* into *Heaven*; to make it a Leſſon for ever, for Mortal Men not to truſt too much unto their own Strength: And to the end he might ſignifie the great enmity between them, he placed them ſo in the *Heaven*, that whenſoever the one Riſeth, the other ſetteth; and they are never both of them ſeen together above the *Horizon* at once: *Gulielmus Poſtellus* will have it to be the *Serpent* which beguiled *Eve* in *Paradiſe*. The unformed *Stars* about this *Scorpion* are three.

9. SAGITARIUS, the *Archer*. It hath 31 *Stars*. Touching this *Sign*, there are among the Poets many and ſundry Opinions. Some ſay that it is *Crocus*, the Son of *Puphene*, that was nurſe unto the Muſes. This *Crocus* was ſo forward in Learning of the Liberal Sciences, and in the practice of Feats of Activity, that the Muſes entreated *Jupiter* that he might have a place in *Heaven*. To whoſe requeſt *Jupiter* inclining, made him one of the 12 *Signs*: And to the end that he might expreſs the excellent qualities of the Man, he made his hinder parts like unto a Horſe, thereby to ſignifie his ſingular knowledge in Horſemanſhip: And by his *Bow* and *Arrow*, he declared the ſharpneſs of his Wit. Whereupon the *Aſtrologers* have this conceit, that he that is born under *Sagitarius*, ſhall attain to the knowledg of many Arts, and be of prompt Wit, and great Courage *Virgil* affirmeth this to be *Chiron* the *Centaur*, who for his ſingular Learning and Juſtice

was made the Maſter of *Achilles*. At which time *Hercules* coming to viſit him (for he had heard both of the worthineſs of the School-Maſter, and of the great hopes of the Scholar) brought with him his Quiver of Arrows dipped in the Blood of the Serpent *Hydra*, but *Chiron* being deſirous to ſee his ſhafts, and not taking heed of them being in his hand, let one of them fall upon his foot, and being greatly tormented, not only by the anguiſh of the poyſon working in the Wound, but much more becauſe he knew himſelf to be Immortal, and his wound not to be recovered by Medicine, he was enforced to make requeſt unto the Gods, that he might be taken out of the *World*, who pitying his caſe, took him up into *Heaven* and made him one of the Twelve *Signs*.

10. CAPRICORNUS, the *Goat*, It conſiſteth of 28 *Stars*. The Poets ſay that this was *Pan*, the God of the Shepherds, of whom they feign in this manner: The Gods having War with the *Gyants*, gathered themſelves together into *Egypt*, *Typhon* the *Gyant* purſued them thither, whereby the Gods were brought into a Quandary, that well was he that by changing his ſhape might ſhift for himſelf. *Jupiter* turned himſelf into a *Ram*: *Apollo* became a *Crow*: *Bachus* a *Goat*: *Diana* lurked under the form of a *Cat*: *Juno* transformed her ſelf into a *Cow*: *Venus* into a *Fiſh*: *Pan* leaping into the River *Nilus*, turneth the upper part of his body into a *Goat*, and the lower part into a *Fiſh*. *Jupiter* wondring at this ſtrange device, would needs have that Image and Picture tranſlated into *Heaven*, and made one of the Twelve *Signs*. In that the hinder part of this *Sign* is like a *Fiſh*, it betokeneth that the latter part of the month wherein the *Sun* poſſeſſeth this *Sign*, enclineth unto Rain.

11. AQUARIUS, the *Waterman*: It hath 42 *Stars*, whereof ſome make the figure of the *Man*: Other ſome the *Water-pot*; & ſome the *Stream* of *Water* that runneth out of the *Pot*. This is feigned to be *Ganimedes* the *Trojan*, the ſon of *Oros* and *Callirhoe*, whom *Jupiter* did greatly Love for his excellent favour and Beauty, and by the ſervice of his Eagle carried him up into *Heaven*, where he made him his Cup-bearer, and called him *Aquarius*. Others notwithſtanding think it to be *Deucalion* the ſon of *Prometheus* whom the Gods tranſlated into *Heaven*, in Remembrance of that mighty Deluge which hapned in his time, whereby Mankind was almoſt utterly taken away from the Face of the *Earth*. The unformed *Stars* belonging unto this *Sign* are three.

12. PISCES, the *Fiſhes*: Theſe together with the *Line* that knitteth them together, contain twenty four *Stars*. The Poets ſay, that *Venus* and *Cupid* her Son coming upon a certain time unto the River *Euphrates*, and ſitting upon the Bank thereof, upon a ſudden eſpied *Typhon* the *Gyant*, that mighty and fearful Enemy of the Gods coming towards them; Upon whoſe Sight, they being ſtricken with exceeding fear, leapt into the River, where they were received by two *Fiſhes*, and by them ſaved from drowning. *Venus* for this good turn, tranſlated them into *Heaven*. *Gulielmus Poſtellus* would have them to be the *Two Fiſhes* wherewith Chriſt fed the 5000 Men. The unformed *Stars* of this *Conſtellation* are four.

Thus have I briefly run over the Poetical reaſons of the *Conſtellations*: It remains now that I ſpeak of the *Milky way*.

VIA LACTEA, or *Circulus Lacteus*, by the *Latins* ſo called; and by the *Greeks Galaxia*; and by the *Engliſh*, the *Milky way*. It is a broad White Circle that is ſeen in the *Heaven*: In the *North Hemiſphere*, it beginneth at *Cancer*, on each ſide the Head thereof, and paſſeth by *Auriga*, by *Perſeus*, and *Caſſiopeia*; the *Swan*, and the Head of *Capricorn*, the Tail of *Scorpio*, and Feet of *Centaur*, *Argo* the *Ship*, and ſo unto the Head of *Cancer*. Some in a ſporting manner do call it *Watlingſtreet*, but why they do call it ſo, I cannot tell; except it be in regard of the narrowneſs that it ſeemeth to have; or elſe in reſpect of that great High Way that lyeth between *Dover* and S. *Albans*, which is called by our Men, *Watling-ſtreet*.

Ovid ſaith, that it is the great Cauſey, and the High-way that leadeth unto the place of *Jupiter*; but he alledgeth not the cauſe of the Whiteneſs: belike he would have us imagine that it is made of White Marble.

Others therefore aledge theſe cauſes: *Jupiter* having begotten *Mercury* of *Maia* the Daughter of *Atlas*, brought the Child when he was born, to the Breaſt of *Juno* lying aſleep: But *Juno* awaking threw the Child out of her Lap, and let the Milk run out of her Breaſt in ſuch abundance that (ſpreading it ſelf about the *Heaven*) it made that Circle which we ſee. Others ſay, that it was not *Mercury*, but *Hercules*; and that *Juno* did not let the Milk run out of her Breaſt, but that *Hercules* ſuckt them ſo earneſtly, that his Mouth run over, and ſo this Circle was made.

Others ſay, that *Saturn* being deſirous to devour his Children, hi his Wife *Ops* preſented him with a Stone wrapped in a Clout, inſtead of his Child: This Stone ſtuck ſo faſt in *Saturn* his Throat as he would have ſwallowed it, that without doubt he had therewithall been Choaked, had he not been relieved by his Wife, who by preſſing the Milk out of her Breaſts ſaved his Life: The Milk that miſſed his Mouth (whereof you muſt ſuppoſe ſome ſufficient quantity) fell on the *Heavens*, and running along made this Circle.

Dr. *Hood Commenting upon Conſtellations, ſaith*; The *Stars* are brought into *Conſtellations*, for Inſtruction ſake, Things cannot be taught without Names: To give a Name to every *Star* had been troubleſome to the Maſter, and for the Scholar; for the Maſter to Deviſe, and for the Scholar to Remember: And therefore the *Aſtronomers* have reduced many *Stars* into one *Conſtellation*; that thereby they might tell the better where to ſeek them; and being ſought, how to expreſs them. Now the *Aſtronomers* did bring them into theſe Figures, and not into other, being moved thereto by theſe three Reaſons.

Firſt, theſe Figures expreſs ſome properties of the *Stars* that are in them; as thoſe of the *Ram* to be Hot and Dry; *Andromeda* Chained betokeneth Impriſonment, the Head of *Meduſa* Cut off, ſignifieth the loſs of that part: *Orion* with his terrible and threatning geſture, importeth Tempeſt and terrible Effects. The *Serpent*, the *Scorpion* and the *Dragon*, ſignifie Poyſon: The *Bull* inſinuateth a Melancholy Paſſion: The *Bear* inferreth Cruelty, *&c.*

Secondly, the *Stars* (if not preciſely, yet after a ſort) do repreſent ſuch a Figure, and therefore that Figure was aſſigned them: As for Example, the *Crown*, both *North* and *South*, the *Scorpion*, and the *Triangle*, Repreſent the Figures which they have.

The third cauſe was, the continuance of the Memory of ſome notable Men, who either in regard of their ſingular Pains taken in *Aſtronomy*, or in regard of ſome other notable Deed, had well deſerved of Mankind.

The firſt Author of every particular *Conſtellation* is uncertain; yet are they of great Antiquity; we receive them from *Ptolomy*, and he followed the *Platonicks*; ſo that their Antiquity is great. Morover, we may perceive them to be Ancient by the Scriptures, and by the Poets. In the 38 Chapter of *Job* there is mention made of the *Pleiades*, *Orion*, and *Arcturus*, and *Mazzaroth*, which ſome interpret the Twelve *Signs*: *Job* lived in the time of *Abraham*, as *Syderocrates* maketh mention in his Book *de Commenſurandis Locorum Diſtantiis.*

Now beſides all this, Touching the reaſon of the Invention of theſe *Conſtellations*, the Poets in ſeting forth thoſe Stories, had this purpoſe, to make them fall in Love with *Aſtronomy*: When *Demoſthenes* could not get the People of *Athens* to hear him in a matter of great Moment, and Profitable for the Commonwealth, he began to tell them a Tale of a Fellow that ſold an Aſs; by the which Tale he ſo wrought on the *Athenians*, that they were both willing to hear his whole Oration, and to put in Practice that whereunto he exhorted them. The like intent had the Poets in theſe Stories: They ſaw that *Aſtronomy* being for Commodity ſingular in the Life of Man, was almoſt of all men utterly neglected: Hereupon they began to ſet forth that Art under theſe Fictions: that thereby ſuch as could not be perſwaded by commodity, might by the Pleaſure be induced to take a View of theſe matters, and thereby at length fall in Love with them. For commonly note this, that he that is ready to Read the Stories, cannot content himſelf therewith, but deſireth alſo to know the *Conſtellations*, or at leaſtwiſe ſome Principal *Star* therein.

FINIS.

A

DISCOURSE

Of the

Antiquity, Progreſs and *Augmentation*

of

ASTRONOMY.

Articl. 1.
Obſervations Cæleſtial, from the beginning of the World; though rude and inartificial.

FIRST it ſeems not to be doubted, but that there was ſome kind of Obſervation of Bodies *Cæleſtial*; as ſoon as there were Men: conſidering that the Spectacle which the *Heavens* conſtantly preſent, is both ſo Glorious, and ſo Uſeful, that Men could not have Eyes to ſee, and not fix them Attentively and Conſiderately thereupon. For, among other Appearances, when they ſaw the *Sun* daily to change the Places of its Riſing and Setting, at certain Times of the Year to approach nearer to the *Earth* in its Diurnal Arch, and at others again to mount up to a Height much more ſublime and remote from it; and that his coming nearer to the *Earth* made *Winter*, and his remove Higher made *Summer*: we ſay, when they Beheld theſe things, doubtleſs they could not but ſeriouſly remark and conſider this viciſſitude, according to which they might expect the Seaſon would be more Hard, or Mild, to them in this lower Region of the World. Again, ſo admirably Various did the Moon appear, in her ſeveral Shapes and Dreſſes of Light, that ſhe could not but invite Mens Eyes, and engage them to frequent Speculations: eſpecially when She aſſumed thoſe various Faces or appearances, at ſet and certain Times, in reſpect whereof it came to paſs, that every Nation Meaſured their Times and Seaſons, by thoſe her conſtant and Periodical Circuits; & this, becauſe thoſe Periods ſucceeded much more frequently than the Erections and Depreſſions of the

Sun. To theſe, we may add that beautiful ſhew of the Nightly *Stars*, undergoing likewiſe their Variations, according to the variety of Seaſons,& more particularly that bright *Star* of *Lucifer*,Riſing ſometimes Later, ſometimes Earlier, and ſometimes not at all,before the *Sun*,and the like. But, what we ſhall principally note, is only this; that though Mankind was Long, before they came to make enquiries into the cauſes of theſe *Cæleſtial* Changes and variations,reſtrained to ſet Periods: yet they Obſerved them from the very Firſt Age, and not only Admired,but alſo accommodated what they Obſerved, to the Uſes of their Lives and their Succeſſours. Here it might not be fruitleſs, to remember that *Prometheus*, who was imagined to have framed the Firſt Man, was alſo imagined to have given him an erected Figure,and ſublime Countenance; to the end he might the more advantageouſly advance his Eyes to the *Heavens*, and contemplate the Glory and Motions of the *Cæleſtial* Lights. But becauſe this is too General, and rude a way of Obſervation; and it is our buſineſs to look back into thoſe Times *wherein Men firſt made ſuch Obſervations of Syderal Bodies,as gave them the hint and occaſion of reducing them to Method, and founding the Principles of the Art, or Science of Aſtronomy, thereupon:* we muſt have recourſe to the monuments in *Sacred Writ*, for the underſtanding of that obſcure matter.

Articl. II. *Sacred records examined, and* Moſes *found to be the Firſt* Aſtronomer *there ſpoken of. lib.* 1. *Ant. c.* 3.

And indeed,the Light we expect from *Sacred Leaves*, would ſoon be clear enough to diſcuſs all the Darkneſs, wherein the Original of *Aſtronomy* ſeems involved; could we but from them deduce the leaſt evidence for that which the learned Antiquary among the Jews, *Joſephus* affirms of the Sons of *Seth*; *viz. that they invented the Science of the Heavens,before the Flood,and engraved the ſame on two Pillars, the one of Brick, the other of Stone, that ſo it might be preſerved in the one, in caſe the Fury of the Deluge to come, ſhould demoliſh and deface the other:* or if there remained to us any the moſt ſlender Teſtimony of the Reaſon he there gives, of the ſo great Longevity of Men in thoſe Days; namely, that the duration of their Lives was ſufficiently long, to perfect the knowledge of *Aſtronomy*, which requires full 600 Years, at the leaſt, to the Obſervation of all the Varieties of *Cæleſtial* Motions: Whereupon he notes, that the Great Year (as they call it) doth conſiſt of ſix hundred Common Years; the vulgar opinion being, that the *Cæleſtial* Motions do continually vary.

cap. 4.

Donec conſumpto, Magnus qui dicitur, Anno, *Epigram. de*
Rurſus in antiquum redeant vaga ſidera curſum, *ætat. Arim.*
Qualia præteriti ſteterant ab origine mundi.

Again, the buſineſs might be deduced from not long after the Flood, if in Scripture we could find but the leaſt word from whence might be argued the truth of what the ſame Author writes; namely, that the *Egyptians were taught* Aſtronomy, *by Abraham.* Probable enough it is, we confeſs, that *Beroſus*, and others, quoted as well by *Joſephus*, as *Euſebius*, had read ſome ſuch thing in ſome Book of the old Rabbins: but that the ſame ſhould be fetched from Holy Writ, is moſt improbable; therein being no mention at all of any ſuch thing. Beſides, there are Pious and Learned Doctors, and among them *Salianus*, who will not allow it to be ſo much as probable, that *Abraham* ſhould inſtruct the *Egyptians* in *Aſtronomy*: becauſe of the very ſmall Time of his ſtay among them in *Egypt*. It is written indeed, that *Abraham came from Ur of the Chaldeans:* but not that he received *Aſtronomy* from the *Chaldeans*, or that he delivered it from them to the *Egyptians*. And therefore they conclude, that what *Joſephus* ſaid of *Abrahams* Reading *Aſtronomy* in *Egypt*, may with more probability be imputed to his Great grand-Child, *Joſeph*, Concerning Him, therefore, we read (in truth) that he was ſingularly favourable to the Prieſts in *Egypt*, at ſuch Time, as all the reſt of the People mortgaged their Lands to the King for Bread, during that woful and long Famine. For, He excepted the Lands belonging to the Prieſthood, and (as the Text ſaith) aſſigned them certain Portions out of the publick Granaries; ſo that from hence may be proved (what *Ariſtotle* tells us from other Authority) that amongſt the *Egyptians*, the moſt Ancient Nation, the Prieſts were exempted from Labour, and left to the eaſie employment of their Minds: and that this gave them occaſion to invent and conſtitute the *Mathematicks*: and yet for all this, it is not written, either that *Joſeph* taught thoſe *Egyptian* Prieſts the *Mathematicks*, or that they taught them to him. And perhaps that Favor he ſhewed the Prieſts, was an Argument not only of the Reſpect and Veneration born them by the King and all his People; but alſo of his particular Gratitude toward them; in that He, who had been bred up only to Sheppardry and

Gen. 11.

Gen. 47.

1. Polit. cap. 1. *and Metaph. cap.* 1.

try Imployments, and was wholly ignorant of all Arts and Sciences,at his firſt coming among them ; being afterwards advanced to the height of a Courtier,and luſtre of a Favorite, had been inſtructed by them in ſomething more noble and ſublime. And truly the Divine *Moſes*, not long after admitted into the ſame Court,is not delivered ſo much to have erudited any others, as to have been himſelf learned in all the Wiſdom of the *Egyptians*.
Acts. 7. Nevertheleſs conſidering that this Wiſdom of the *Egyptians*, doubtleſs contained the *Mathematicks* ; and that *Aſtronomy* was ever eſteemed the beſt and nobleſt part of them : this Erudition of *Moſes* ſeems to be the moſt Ancient Monument of the Science of the *Stars*, that can be found in Holy Writ.

Aſtronomy you ſee is of great Antiquity, even upon the Records of Divinity ; and might be proved of much greater, could we but evince (what ſome alledge) that the Hiſtory of *Job* was
Cap. 9. Pen'd by *Moſes*, as living a good while after him. Becauſe *Job* there mentions *Arcturus*,*Orion*,and the *Hyades*,or watery *Conſtellation* : and therefore it muſt be,that before that Time the *Stars* had been ranged and diſpoſed into certain *Aſteriſms*, according to ſome certain method or artificial Theory then in Uſe. But be the Time of his life never ſo uncertain,yet we may certainly obſerve from the Hiſtory thereof; that it ſeems *Job*, being an Alien to the *Hebrews*, derived his knowledge of God from that which in Scripture is called *Cœlorum Exercitus* the *Hoſt of Heaven*.For aſmuch,as the Inviſible things of God are not ſo well learned from any viſible things of Nature,or the effects of his Wiſdom & Power, as from the *Cœleſtial* Orders, and therefore *Syneſius* juſtly
Dedone ad Pæn. calling *Aſtronomy* [ὑπερσέμνον ἐπιστήμην] *a truly-venerable Science* ; he ſaith, that it advanceth the Mind to ſomething of greater both Antiquity and Nobility, *viz.* ineffable *Theology*. That we may be brief, and only touch upon that ſentence in the Book of *Wiſdom* that God gave to *Solomon*, among other of Natural
Cap. 7. Sciences,to *underſtand the Courſe of the Year,and the diſpoſitions of the Stars :* If any thing in Sacred Writ doth expreſly prove the Antiquity of Obſervations *Aſtronomical*, and the founding or erecting any ſetled Art thereupon ; it muſt be that, of which
Iſa. 47. the Holy Prophets complain'd in their days ; *viz.* that there were Chaldeans who at *Babylon did contemplate the Stars, and compute the months,that from them they might foretel things to come.* For, from hence we underſtand, that the Obſervations of the Motions of *Heavenly* Bodies was a certain profeſt Art ; and of

great Antiquity among the *Chaldeans*.

Articl. 3.
Ethnick *monuments likewiſe revolved; and firſt thoſe of* Fabulous *times: according to which* Cœlus *is found the moſt ancient Aſtronomer.*

In the *Second* place we are to revolve the Records of *Ethnick Authors*, to ſee if among them we can find the Time of the Nativity of *Aſtronomy*.

Look we therefore back. Firſt,into the Remains of that part of Time,which is called *Obſcure* or *Fabulous*,becauſe poſſibly enough ſomething of Truth, concerning our enquiry, may be found wrapt up in the darkſome ſhrouds of *Fables*. And begin we at the moſt Ancient of Heathen Gods,*Cælus*, in Greek 'Ουρανὸς who,as *Diodorus Siculus* delivers, was ſo named, becauſe of his High Devotion to,and delight in the Obſervation of the *Stars*. This eminent Perſon being the Father of many Sons, as *Atlas*, *Saturnus*, the *Titanes*,and among thoſe, eſpecially *Hyperion* and *Japetus*, it is lawful for us to conjecture, that led by his Example, his whole family were addicted to the ſame Study. For ſeeing, that *Cælus* lived in *Mauritania*,not far from the Ocean;and thence extended his Kingdom,not only over all *Africa*, but alſo into a conſiderable part of *Europe*:it is well known that his Son *Atlas* who ſucceeded him in the ſame Dominions,is allowed to have given his name to the higheſt Mountain of that Country; only becauſe he had made his Obſervations of the Motions of the *Heavens* and *Stars*,from the top thereof. For the Ancients in thoſe Days, as the Vulgar now in ours, imagined the Arch of the *Heavens* to be ſo little diſtant from the tops of great Mountains,as that by how much the Higher any man aſcended on thoſe Hills, by ſo much the more clearly & diſtinctly might he behold *Cæleſtial* Objects. To this,*Diodorus*,*Pliny*, and others add;that *Atlas* was feigned to ſupport *Heaven* on his Shoulders,only becauſe he had Framed a *Sphere*, wherein the whole *Heavenly* machine was ſtrongly repreſented:and *Clemens Alexandrinus* Obſerves,that *Hercules*, being both *Vates* & *Phyſicus*,a Prophet and Philoſopher,was reported to come and relieve *Atlas* (his great Uncle) by taking the vaſt Burden of *Heaven* upon his own Shoulders;becauſe He ſucceeded him in that difficult Task,the Study,or ſcience of *Cæleſtial* Bodies. Of *Heſperus*, the Son of *Atlas*, it is recorded, that while he was buſie in ſpeculating the *Stars*,on the top of the ſame Mountain, he was ſnatched away by the violence of ſome Diſeaſe, & could never be found: & that thereupon,the common People,in reſpect of his Piety and Juſtice, gave his name to the moſt beautiful and reſplendent *Star*,which is alſo called *Veſperugo*,being *Venus*,while

lib. 3.

and after him his Sons.

1.
Atlas, *who taught Aſtromy to his Son.*

lib. 3.
lib. 2. *cap.* 8.

Strom. 1.

Heſperus.

ſhe

And Daughters, the Atlantiades *and* Pleiades, *from one of whom came* Mercury.

1. Aſtron.

She is in the *Weſt*. As for his Siſters, called both *Atlantiades*, and *Pleiades*: theſe likewiſe gave their name to that Glomeration of *Stars*, which are viſible in the Back of *Taurus*, and of one of them, named *Maia*, was born the famous *Mercurius*; ſaid to have brought the Science of the *Stars* firſt into *Egypt* Whence *Marcilius*, writing of the *Aſtronomy* of the *Egyptians*, Says of *Mercury*.

Tu Princeps, Authorq; Sacri, Cyllenie, tanti. &c.

lib. 3.
lib. de Aſtrol.
5. *Tuſculan.*

Though we well know, that the *Ethiopians*, allowing the *Egyptians* to be no other, but one of their *Colonies*, ſent abroad to find room to ſubſiſt in, contend, that they received *Aſtronomy* from them: as firſt *Diodorus*, and after *Lucian* have obſerved. Here it is well worthy our Commemoration, what *Cicero* ſaith, as of *Atlas* and *Prometheus*, ſo alſo *Cepheus*, a King of the *Ethiopians*: *viz.* "Neither had *Atlas* been believed to have ſuſtain'd *Heaven*, nor "*Prometheus* to have been chain'd on *Caucaſus*: nor *Cepheus* with "his Wife, Son-in-Law, and Daughter, to have been Stellified: "had not their Divine cognition of *Cœleſtial* Bodies firſt occaſi-"oned the perpetuation of their Names in the Diſguiſe of Fables.

2.
Saturn, *who delivered the ſame to his Son.*

To return to *Saturn* another Son of *Cœlus*; He leaving *Africa*, and Reigning only in *Italy*, *Sicily* and *Crete*; may be thought to have proſecuted his Fathers Studies, no leſs than the former: and we have this Argument for it, that the floweſt of all the *Planets* bears his Name, to this very Day: probably, becauſe he was the firſt who underſtood the Motion and courſe of that *Planet*, which was by the *Greeks* called Κρόνος from χρόνος *Time*, foraſmuch as of all the *Cœleſtial* Circuits, none was found ſo diuturn. And of his Sons, ſince *Pluto* addicted himſelf intirely to *Huſbandry*, *Neptune* to *Navigation*, we may conceive, that *Jupiter* applying his mind to nobler cares, ſucceeded his Father in the Study of the *Heavens*: as alſo that he choſe *Olympus*, accounted the higheſt Mountain, to make his Obſervations upon: ſo that in proceſs of Time he came therefore to be called *Olympus*; and the name of that Mountain to be transferred upon *Heaven* it ſelf, whoſe orders and laws he well underſtanding, was thereupon ſaid to have the Dominion of *Heaven*.

Jupiter.

Iſagog. ad Phœn.

Certain it is, that the *Grecians* aſcribed the Original of this nobleſt Science, partly to the *Gods* themſelves, and partly to ancient *Hero*'s, which *Achilles Tatius* ſeaſonably alluding unto, introduceth old *Æſchylus* attributing to God, that He ſhewed the

Riſings and Setting of the *Stars*, and diſtinguiſht Winter, Summer, and the other Seaſons; and *Ovid* Fathers the ſame wholly upon *Jupiter*.

> *Perq; Hiemes, Æſtuſq; & in aquales Autumnos,*
> *Et breve Ver, ſpatiis exegit quatuor Annum.* *I. Metamorph.*

Beſides, it is in the Fiction that *Jupiter* took his Father, *Saturn*, bound him, and precipitated him into *Hell*. Now this ſeems to intimate, that *Jupiter* having impoſed his own name upon one of the moſt eminent and illuſtrious of the *Planets*, gave that of his Father to another of them, that was more remote, ſituate in the deepeſt parts of the *Æthereal* ſpaces, and of the ſloweſt Progreſs: though all this while we are not ignorant, that thoſe names were fixed upon thoſe *Planets* a long Time after: ſince more anciently the *Planet Jupiter* was called *Phaeton*, and that of *Saturn*, *Phænon*. For, we may collect very near as much from *Lucian*, who by *Tartarus* underſtands the immenſe Altitude, or Profundity of the *Æthæreal* Region: and ſo denies that *Saturn* was either exil'd by *Jupiter* into *Hell*, or caſt into bonds; as common Heads were perſwaded to believe.

3. Hyperion.

As for *Hyperion*; *Diodorus* hath a Tradition, that he being of the Progeny of old *Cælus*, demonſtrated the courſes of the *Sun* and *Moon*: and therefore called the *Sun Helios*, after the name of his *Son*; and the Moon, *Selene*, after that of his *Daughter*.

4. Japetus. *From whom came* Prometheus, *who followed the ſame ſtudy. in Eccl.7.*

Laſt of all comes *Japetus*, who alſo was the Son of *Cælus*, but performed nothing worthy commendation in the advance of his Fathers Speculations: but *Prometheus*, whom he Begat, was therefore imagined to have been chained on the Hill *Caucaſus*, and to have his Heart perpetually torn by a hungry *Eagle* or *Vultur*; Becauſe (as *Servius* expounds the Riddle) with reſtleſs care, and ſolicitude of Mind, he conſtantly excruciated himſelf with Obſerving the *Stars*, and Studying their *Aſcenſions* and *Declinations*. We ſhall not inſiſt upon what follows in the ſame Author, namely that this *Prometheus* was the firſt, who introduced *Aſtrology* to the *Aſſyrians* (not far from *Caucaſus*:) it being more uſeful for us now to obſerve, that He was imagined to have ſtollen *Fire* from *Heaven*, for the inanimation of Man, for no other reaſon, but becauſe he infuſed this *Heaven*-fetch't Knowledge into the Breaſts of Men, and inflamed their Souls with the deſire and Love thereof.

For, as to the remainder; foraſmuch as *Belus* was the ſame with *lib.* 2. *Jupiter*, among the *Aſſyrians*, as *Diodorus* teſtifieth: it is He rather, *lib.* 37. *c.* 10. who was accounted both the moſt ſacred of their Deities, and the Inventor of this *Sideral* Science; as *Pliny* affirms.

ſo did Phaeton. It is not needful for us here to examine many other of the ancient Traditions, accounted likewiſe among the Fabulous; as, in particular, the Fable of *Phaeton*, which hath this Mythology, that in his Life Time he had made a conſiderable progreſs toward the diſcovery of the *Sun's Annual* Courſe; but dying immaturely, he left the Theory thereof imperfect. That other of *Bellerophon*, whom Interpreters maintain to have been carried up to *Heaven*, not by a Flying Horſe, but a Studious and contemplative Mind, Dædalus, Icarus. eager in the queſt of *Syderal* myſteries. That of *Dædalus*, who indeed, by the ſame towring Speculations, as by the Artifice of Wings, mounted up to the *Northern* part of *Heaven*; while his leſs ingenious Son, *Icarus*, falling ſhort in his attempt of imitating his Fathers ſublime Flight (as not ſo well underſtanding the Demonſtrations of the reaſons of his Theory) flagged very low in his Studies: and fell from the true and apodictical cognition of *Cæleſtial* Motions and viciſſitudes: with many other the like, re- *de Aſtrol.* counted by *Lucian*; as that of *Endymion*, the favourite of the *Moon*; *in Iſagog.* of *Tireſias*, the Prophet, &c. Yet one thing there is mentioned as well by *Lucian*, as *Tatius*, which we cannot well paſs by; which falling under the account of Heroical Times, ſeems to come ſomewhat near to that which is called Hiſtorical. And that is Atreus *and* Thyeſtes. the notable Contention that aroſe betwixt *Atreus* and *Thyeſtes* about ſupream Dominion. For when by the publick Conſent and Vote of the *Argives*, the Kingdom was to be his of the Two, who ſhould give the moſt eminent Teſtimony of Science: it came to *Atreus* ſhare to be King: becauſe, though *Thyeſtes* ſhewed them the *Sign Aries*, in *Heaven* (for which he was honoured with a golden *Ram*) yet had *Atreus* declared a thing more excellent; while diſcourſing about the Variety of the *Sun's* Riſing, he made it appear, that the *Sun* and the *World* (*i.e.* the *Starry Orb*) were not carried the ſame, but quite contrary Ways, and conſequently, that that part of the *Heavens* which was the *Weſt* or *Occident* of the *Starry-Orb*, was the very Riſing, or *Orient* of the *Solary*. Hence that Verſe of *Euripides*,

Δείξας γὰρ ἄστρων τὴν ἐναντίαν ὁδὸν
Qui Aſtrorum enim contrariam oſtendit viam.

To the ſame Times likewiſe are we to refer the Inſtitution of the *Olympick Games*, by *Hercules*: which after a long interruption were renewed by *Iphitus*. For, inaſmuch as thoſe Sports were inſtituted for no other end (as may be aſſured from *Cenſorius*) but that their Celebration might put men in mind of that *Intercalation* of a Month and half, that was to be made conſtantly every fourth Year, in reſpect of thoſe four Times eleven, or forty four Days, by which the Motion of the *Moon* anticipated that of the *Sun*; and the four times ſix Hours, or one whole Day, by which the circuit of the *Sun* exceeded 365 Days: manifeſt it is, that *Hercules* could not underſtand this, without having firſt exactly Obſerved the Motions of the *Sun* and *Moon*. Hither alſo belongs that which is reported of *Orpheus* who muſt needs have attentively Obſerved the ſeven *Planets* if it be true, as *Lucian* avers, that he repreſented their Harmony by his *Sevenſtringed Harp*: which the *Grecians* thereupon deſigned in *Heaven*, by ſome *Stars*, that to this Day retain the name of *Lyra*. So likewiſe doth what *Sophocles* ſaith of *Palamedes*, who pointed out the ſeveral *Aſteriſms*, and particularly,

Hercules *and* Iphitus.

cap. 18.

Orpheus.

de Aſtrol.

Palamedes.

Ἄρκτȣ Στροφάς τε, ϗ κύνος ψυχρὰν δύσιν
Urſum volutam: gelidum & occaſum Canis.

And laſtly, what *Homer* recounts, that in thoſe Times were well known (beſides *Boetes* and the *Bear*, or *Wain*)

Homer.

Πληϊάδας θ' Ὑάδας τε, τὸ σθένος Ὠρίωνος
Pleiades, atq; Hyades, roburq; ipſum Oriones.

Odyſſ. E.

We have now ſtruggled through the Darkneſs of Fabulous Times, and are advanced as far as to diſcern the Twilight of *Hiſtorical*. And here, the firſt thing we clearly perceive, is that the whole Controverſie about the Antiquity of *Aſtronomical Obſervations* lies betwixt the *Egyptians* and the *Aſſyrians*, or *Babylonians*. For, as to the *Grecians*, though ſome have thought they might put in alſo for a claim to the Honour of being the Authors of this admirable Science; yet by the Verdict even of *Plato* himſelf, they are to lay by the pretence of competition; "For, ſaith He, The firſt that made *Syderal* Inſpections, was a "*Barbarian*, a more Ancient Nation than Ours bred thoſe Men

Articl. 4.

Secondly, thoſe Hiſtorical *times; according to which, the antiquity of Aſtron. Obſervations belongs either to the* Egyptians, *or* Babylonians.

in Epinom.

“ who firſt devoted their minds to that Study, in reſpect of the
“ *Summer*-like ſerenity and perſpicuity of the *Air*, ſuch as *Egypt*
“ enjoys, and *Syria*, where all the *Stars* are clearly viſible, and
“ no Clouds or Miſts to obſcure the beautiful Face of *Heaven*.
And certainly, if we except what we newly mentioned, the Inſtitution of the *Olympick Games* by *Hercules*, and the Reſtauration of them after ſome Intermiſſion, by *Iphitus*, which hapned about 800 Years before Chriſt; and ſome places in the Writings of *Homer*, and more eſpecially of *Heſiod*, who lived near upon the ſame Time, or not long before; we ſhall find that the *Grecians* can produce no Monuments of their Obſervations of the *Heavens* more Ancient than thoſe of *Thales*, who flouriſhed full 600 Years before Chriſt; and who yet borrowed his knowledge of *Ætherial* Matters from *Egypt*. It being manifeſt therefore, that the *Egyptians*, or their Prieſts, are the only Men, that ought to be admitted to diſpute with the *Aſſyrians* or *Babylonians*, or their Philoſophers, concerning the Antiquity of Obſervations, and that their ſeveral Pleas ſeem equally reaſonable. Truly, it is no eaſie matter to determine the difference, ſo as to place the Lawrel on their Heads to whom it doth of right belong. For, albeit *Joſephus* aſſigns the Honour to the *Chaldæans*; and others again ſtand firmly for the *Egyptians*: Yet *Plato*, *Diodorus*, *Lucian*, *Achilles*, *Tatius*, and others alledge ſuch quotations for each party, as ſeem to have no other, but the Authority of the Parties themſelves. Nor ought that to ſeem ſtrange; ſince both ſides equally alledge the convenience of their vaſt Companies, & the Serenity of the *Sky*; ſince they both boaſt themſelves the Original Nation, and allow their Competitors to be only *Colonies*; ſince both glory in Fabulous beginnings, which we cannot trace or diſcuſs; & both recur to egregious falſhoods about the time when their Anceſtors firſt made *Cœleſtial* Scrutinies. For, the *Chaldæans* (as we find in the Regiſter of *Diodorus*) affirm, that their Nation applied themſelves to theſe Studies, from times of Incredible Antiquity, *viz.* of four hundred and 3 thouſand Years: And the *Egyptians* (as *Cicero* Obſerves) talk of Obſervations of four hundred thouſand and ſeventy Years ſtanding. Unleſs you ſhall pleaſe to conſign the Victory to the *Egyptians*, becauſe they put a value on themſelves by Auction. As if it were not enough for them to boaſt thoſe four hundred nine thouſand Years (mentioned by *Laertius*) in which from the time of *Vulcan*, the Son of *Nilus*, to

1. *Antiq.* 8. *in Epinom.*
2. *lib. de Aſtrolog. Iſagog.*

Loc. citat.

de Divinat.

that of *Alexander* of *Macedon*, there happened of *Eclipſes* of the *Sun* three hundred ſeventy three, and of the *Moon* eight hundred thirty two. Theſe Conſiderations premiſed, we cannot indeed deny but the *Egyptians* had ſome Obſervations, ſome Ages before *Thales* and other *Grecians* Travelled among them: But when we would enquire more preciſely into the Time, when thoſe Obſervations firſt begun; we find our ſelves at a loſs, and brought back again into the Cimmerian obſcurity of Fabulous Times.

In præfat.

Now foraſmuch as, tho *Pliny* writes, that *Epigenes* found no Obſervations among the *Babylonians* of above ſeven hundred and twenty Years Antiquity, and thoſe engraven on Artificial Tiles or Slates; and the moſt ancient *Eclipſes* deduced from them, were tranſmitted to *Ptolomy*, about the ſame number of Years before Chriſt; and that by the great *Hipparchus*. And to the ſame Time belongs what *Beroſus* & *Critodemus* ſay, that in their Days there were extant no Obſervations of more than four hundred and thirty Years, as may be found alſo in *Pliny*: Foraſmuch, we ſay, as we have brought ſome conſiderable Monuments of Obſervations much elder than that time; yet ſhall not concede beyond what the *Caldæans* themſelves profeſt, when they teſtified to *Caliſthenes* (who went to them upon no other Errand, by the perſwaſion of *Ariſtotle*, as *Simplicius* relates) that they had nothing of that kind among them beyond a thouſand nine hundred and three Years paſt: Which Years ſeem to commence at *Ninus*, the Son of *Belus*, and firſt King of the *Aſſyrians*. It is clear, that the Antiquity of Obſervations ariſeth to (but not above) one thouſand and ninety Years before *Alexander* the Great.

lib. 9. c. 55.

In Almageſt. lib. 4. cap. 6.

In lib. 3. de Cœlo, and comment 46.

But, alaſs! After all this great ado, *What did the Obſervations themſelves amount unto?* Why truly, for ought we can gather from all that is Extant concerning them, thoſe of the *Egyptians* amounted to nothing at all; and thoſe of the *Caldæans* to very little. For the *Egyptians*, we confeſs, are ſaid to have Obſerved the Riſing of the *Dog-Star*, and ſome other, no very difficult Appearances: But we have no remains delivered down to us, of that or any other particular they Obſerved, with the exact deſignation of the Time as they ought. And from the *Caldæans* we have as little, beſides thoſe *Eclipſes* mentioned in *Ptolomy*. But when I ſpeak of the *Egyptians*, I except *Ptolomy* himſelf, and ſome others who lived and Studied at *Alexandria*, about three hundred years before the Nativity of our Saviour; or after *Alexander*: As *Timocharis*, *Eratoſthe-*

Article 5.
Yet neither of them Obſerved any thing conſiderable: As to the deſignation of Times: But corrupted what they had Obſerved, to the Introduction of Aſtrology Judicial.

nes, *Hyparchus*: for all theſe were either *Grecians*, or to be accounted among the *Grecians*, in reſpect of the Language they uſed and wrote in, rather than amongſt the ancient *Egyptians*, by whoſe Inventions even *Ptolomy* himſelf (one of their own Country-men, without diſpute) was very little, or nothing at all aſſiſted in his Study of *Aſtronomy*. But, what concerns as well the *Egyptians*, as *Chaldæans*; their Obſervations are to be diſtinguiſhed (according to the diviſion vulgarly received) into (1.) *Aſtronomical*, and (2.) *Aſtrological*: the former relating to the Motions, Magnitudes, Diſtances, and proportion of the *Stars*; the Latter to the Effects of them, which they conjectured were dependent on the Vertues and Influences of Heavenly Bodies, as well in the affections of the *Air*, as in the Actions and Affairs of Mankind. For, both Nations being wonderful prone to Superſtition, and ſurpriſed with exceſs of Admiration at the *Eclipſes* of the *Sun* and *Moon*, when they firſt beheld them; and Obſerving ever now and then ſome *Stars* that moved in Courſes contrary to the *Weſt*, they began preſently to think, that thoſe Appearances happned not without Natural Cauſes; and that it remained only on Mans part, to Study how thoſe Events might come to be foreknown which thoſe appearances did portend. Hereupon, having *Loc. citat.* attributed the moſt powerful Vertue to the five Wandering *Stars* (as *Diodorus* teſtifieth particularly of the *Chaldæans*) as underſtanding them to be the Proclaimers of the Will and Purpoſes of the Gods; becauſe they ſometimes Aroſe, and ſometimes Set in various Places of the *Heavens*, becauſe they varied their Magnitude and Colour: therefore they conceived, that they ought to addreſs their Studies and Diſquiſitions principally to theſe Varieties. And, becauſe they imagined, that the higher the Place was, from whence they ſhould Obſerve theſe Wandering *Stars*, the more clearly and diſtinctly might they be diſcerned; they builded Structures of vaſt Altitude; and particularly that immenſe Tower at *Babylon*, deſcribed by *Herodotus*, from the *lib.* 10. higheſt Area whereof (where ſtood alſo the Temple of *Belus*) they might exactly Behold and Obſerve the Riſing and Setting of the *Stars*, and other *Syderal* occurrences. They took notice likewiſe, that thoſe five *Planets* did keep almoſt the ſame Courſe, as the *Sun* & *Moon*, and thereupon they pointed out the *Zodiack*; imagining that there muſt be ſome eminent Vertue in that part of the *Heaven*, becauſe all the *Planets* kept conſtantly to it. And this *Zodiack* they divided into twelve parts, or *Signs*; becauſe the *Moon* run it over twelve times, and the *Sun* only once in one Year: and according to the number of the Days, during which the *Sun* was in paſſing through one *Sign*, they diſtinguiſhed each *Sign* again into thirty parts, which we call Degrees. I ſhall not recount to you, how they would have Twelve Principal Deties belonging to theſe Twelve *Signs*, whereof each had his particular Regiment over his proper *Sign* and *Month* dependent thereupon: nor how they ſubſtituted thirty of the fixt *Stars*, to aſſiſt the *Planets*, and called them *Councelling Gods*: nor how they placed twelve *Stars* always viſible in the *North*, for government of the Living; and as many more in the *South*, always viſible, for the government of the Dead, there gathered together, with many other the like Dreams and ridiculous abſurdities. But the thing I think moſt worthy your notice, is, *by what rude kind of Artifice they diſtinguiſhed the* Zodiack *into Twelve Signs*; as we find it deſcribed, concerning the *Chaldeans*, by *Sixtus Empiricus*, and concerning the *Egyptians*, by *Macrobius*. *ad Aſtrolog.* 1. *in Somn.* 21.

The manner was this, They took a Veſſel with a ſmall hole in the Bottom, and filling it with Water, ſuffered the ſame to diſtil Drop by Drop into another Veſſel, placed beneath to receive it; and this from the Moment of the Riſing of ſome one *Star* or other, Obſerved in one Night, until the Moment of its Riſing again the next night following. The Water fallen down into the Receiver, they divided into twelve equal parts, and having two other ſmaller Veſſels in readineſs, each of them fit to contain one twelfth part of the Water, they again poured all the Water into the upper Veſſel, and ſtrictly marking the Riſing of ſome one *Star* in the *Zodiack*, they at the ſame Moment gave the Water leave to diſtil into one of the ſmaller Veſſels, and ſo ſoon as that was filled, Obſerving likewiſe another Riſing *Star*, they put under another ſmall Veſſel; and ſo alternately ſhifting the ſmall Veſſels, they noted, if not in one Night, yet in many, the twelve *Stars*, by which they might diſcriminate the whole *Zidiack* into twelve equal parts. Now with what Art and exactneſs theſe Ancients meaſured out the *Heavens*, may be conjectured from this one example. I might adfer another foppery of the *Chaldæans*, from the ſame *Empiricus*, who relates, that taking it for granted, that the future Fortunes of Men did depend on their particular *Horoſcope*, or *Sign* Riſing at their Birth: when they had a mind to divine in this Kind. Two of theſe Wiſe Men agreed together in the Calculation of the Nativity of the Perſon propoſed: The one ſtood by the Mother in Travel, the other on ſome high Place near at Hand, and as he that was below gave the Sign, that the Infant was then newly come into the *World*, the other above took care to Obſerve the *Sign* that was juſt then newly Riſen. But, it will be of more uſe for us to hear what *Macrobius* tells of the *Egyptians*. They, when they would know the Diameter of the *Sun*, had in readineſs a Veſſel of Stone, hollowed to the form of an *Hemiſphere*, exactly made, with a *Style* or *Gnomon* erected in the Middle, and twelve Horary Lines drawn within: And on the very day of the *Equinox*, Obſerving the Moment, when the upper Limbus of the *Sun* firſt ſhewed it ſelf above the *Horizon*; they marked that place on the brim of the Veſſel, on which the *Gnomon* caſt its Shadow. Then again marking that Place, on which the Shadow ended, when the lower Limbus of the *Suns* body appeared juſt above the edge of the *Horizon*; they meaſured the ſpace or diſtance betwxt the two marks of the Shadows, and found it to be the ninth part of an Hour, or the hundred and eighth part of *Hemiſphere*, and conſequently the two hundred and ſixteenth part of the whole Circuit: And from thence they deduced, that the Diameter of the *Sun* was the two hundredth and ſixteenth part of its whole *Orb*; (which, in truth, is the 700*th*. near upon) or did contain one Degree and an hundred Minutes; which yet is no more than half a Degree, or 31. Minutes, at moſt. To this we might ſuperadd, that it was the Practice of Elder Times, to commenſurate the Diameter of the *Sun* by an *Hydrologie*, or Veſſell of *Water*; collecting the ſame from part of the *Water* flowing down the whole Day, which had dropped untill the *Sun* was wholly Riſen; as is inſinuated by *Plutarch*, and deduced from *Capella*: But *Cleomades* hath at large declared, that this way of meaſuring by *Water* falling ſlowly and equally from Veſſel to Veſſel, was an Invention of the *Egyptians*. Now the reaſon why we touch upon theſe Particulars, was only to ſatisfy, that (as we ſaid before) no great matter in *Aſtronomy* was ever Obſerved either by the *Egyptians*, or by the *Babylonians*.

Ibid cap. 20.

And, if you deſire any further Argument thereof; Pray take this. They were very far from ſuſpecting, that the Fixt *Stars* had any Motion proper to themſelves; or that they had any *Eccentricity*

tricity (excepting only that the *Egyptians* thought *Venus* and *Mercury* to Move round about the *Sun*, as their Center; as is affirmed by *Macrobius*, and ſome others) or that the *Sun* had any *Apogæum* at all; with many other particulars fully as conſiderable. Which doubtleſs muſt be the reaſon, why they invented no *Hypotheſes*, by which they might regulate themſelves, in making their Calculations of the various Motions of the *Heavenly* Bodies. And *Peter Ramus* not long ſince complained, that we have not our *Aſtronomy* free from the trouble of *Hypotheſes*; ſuch as the Interpreters of *Ariſtotle* themſelves, and *Proclus* on *Timeus* have Recorded the *Egyptians* and *Babylonians* to have had amongſt them: While, in troth, he Complained, that we had not our *Aſtronomy* as rude, wild and imperfect, as theirs was. For, however ſome *Hypotheſes* are more ſimple (and ſo more eaſy) than other-ſome, yet it is abſolutely impoſſible, that *Aſtronomy* ſhould conſiſt without ſome or other. Hereupon, they could Obſerve, indeed, that the Planets were one while *Direct* in their Progreſs, another while *Retrograde*, and then again *Stationary*; that they in their Wandrings ſometimes inclined towards the *North*, and ſometimes deflected again towards the *South*: but all that while, they could neither comprehend the Reaſons of thoſe various Appearances, nor Calculate them by Numbers. The moſt they could do, was darkly to repreſent thoſe Motions, by certain *Hieroglyphicks*, as in particular by the Windings and flexures of Serpents; and the Motion of the *Sun*, only by a Beetle rowling his Pill of Dung backward: as we may read in *Clemens Alexandrinus*: And then came *Eudoxus*, who having learned the variety of Motions among them, was the firſt who invented *Hypotheſes* of various *Orbs*, for the Solution of the *Phœnomena*.

Again, they were very far from attaining the determinate Places of the Fixt *Stars*, according to *Longitude* and *Latitude*, or according to their *Right Aſcention*, and *Declination*: So that neither could they define the true Places of the *Planets*, by Comparation to the Fixt *Stars*, nor (conſequently) deſign any Obſervations with due exactneſs. And truly this was the Cauſe why *Hyparchus* met with no Obſervations either of the *Egyptians* or *Babylonians*, by which he could receive the leaſt help or advantage, toward his compoſing either *Hypotheſes*, or Tables to Repreſent the Motions of the Five Errant *Stars*: And *Ptolomy* was the firſt, who partly by the benefit of Obſervations left him by *Hipparchus*, and partly by thoſe he made Himſelf, became able to attempt ſuch a Work; as ſtands recorded in his *Almageſt*. There were only the the *Eclipſes*, which both theſe Nations had ſet down, as Obſerved in their Commentaries: and thoſe only ſo, as that from Paſt, they might be able to conjecture ſomething of that were to Come. Not from the Motions of *Sun* and *Moon*, exactly Calculated by the help of *Tables*; but having learned from common experience, that every ninetieth Year, *Eclipſes* did return again upon the ſame Day, for the moſt part: thereupon they endeavoured to predict what *Eclipſes* would happen, and the Time when; and this after they had perceived not any *Anomaly* in the *Sun*, but ſome certain Inequality in the *Moon*, which reducing to a medium, they concluded that the *Moon* did every Day run through thirteen Degrees, and a little more than one ſixth part of a Degree, as *Geminus* delivers of the *Chaldæans*. But in their Predictions of *Lunar Eclipſes*, they were ſomewhat more confident; as well becauſe theſe *Eclipſes* uſually return, for the three Ages next ſucceeding, within the compaſs of the ſame Days; as becauſe it is very rare, in reſpect of the greatneſs of the *Earths* Shadow, but the *Moon*, either in the whole, or ſome part of Her, more or leſs falls into it: but, becauſe (as to *Solary Eclipſes*) the *Moon* is both ſo ſmall, and hath ſo large a *Parallax*, as that ſhe doth not for the moſt part intercept the Light of the *Sun* from the *Earth*: therefore was it (as *Diodorus* witneſſeth ſpecially of the *Babylonians*) that they durſt not determine *Eclipſes* of the *Sun* to come, to any certain Time: but if they predicted any, with limitation of Time, they always (to ſave their credit in caſe of failing) annexed this Condition, *If the Gods be not prevailed upon, by Sacrifices and Prayers, to avert thm.*

Truth is, theſe *Aſtronomers* were alſo Prieſts, and it was their intereſt to caſt in this Proviſo. For, being ambitious to be reputed interpreters of the Will of the Gods to the People, and ſo both knowing in things to Come, and skillful in ſuch Ceremonies, wherewith their reſpective Deities were moſt atoned and delighted: unwilling to be thought able to predict nothing, and as unwilling again to be found erring in their chief Predictions, they wrapt up all in myſteries, and amuſed the Vugar with ſuperſtitious Opinions and Rites. The *Egyptians*, in a great part of their Sacred Worſhip, had recourſe to the *Aſtrological* Books of their *Mercurius* (one of the Order of the Fixt *Stars*;a ſecond of the Conjunction of *Sun* and *Moon*; a third and fourth, of their riſing)which with what Ceremonious Pomp they uſed to carry about with them, in a kind of ſolemn Proceſſion, you may find amply deſcribed by *Clem. Alexandrianus.* Nor is it ſtrange that thoſe Prieſts accounted ſo Sacred and Knowing, ſhould alſo be eſteemed for Prophets. Further, you meet with no mention of the Five Errant *Stars*, all this while; and the Reaſon ſeems to be, becauſe they attributed an energie of them only as they were referable to the Inerrant or Fixt: and particularly, as they poſſeſt this or that part of ſome *Sign* in the *Zodiack*, and together with it had their Riſing, or Setting. For, ſo much did they aſcribe to the *Zodiack*, as that the *Babylonians*, and (in imitation of them, the *Perſians* and *Indians*) thought, that each decimal of Degrees, or Thirds of the *Signs* (and the *Egyptians* came as low as to each ſingle Degree) could not be varied in the Riſing, but ſome eminent variation muſt happen, eſpecially in him, who ſhould be born at that Time. And hereupon was it, that the *Egyptians* made that great Circle of Gold (deſcribed in *Diodorus*) of a Cubit in thickneſs, and three hundred ſixty five cubits in Circumference (plundered at laſt by *Cambyſes*) that upon each cubits ſpace might be inſcribed each Day of the Year, 365 Days in the whole round, and alſo what *Stars* did Riſe, what Set upon each Day, nay the very Hour of their reſpective Riſing and Setting, and what they did ſignifie: and whereas others uſed to aſſign the form of ſome Animal or other,to each ten Degrees; they aſſigned one to each ſingle Degree, and ſo made their Hariolations or conjectural Predictions accordingly. For *Example*; to the firſt Degree of *Aries* they aſſigned the figure of a Man,holding a Sickle or Hook in his right Hand,and a Sling in his left; to the ſecond, a Man with a Dogshead,his right Hand ſtretcht forth,and a Staff in his left, and ſo of the reſt: then annexing the ſignification to each, they determined,that he, who ſhould have the firſt Degrees of *Aries* for his *Horoſcope*,ſhould be ſome part of his life a Husbandman, and the reſt of it a Soldier;that he, who ſhould be born under the ſecond, ſhould be contentious, quarrelſome, and envious; and ſo of the reſt, all which *Scaliger* hath fully deduced from *Aben Ezra.* In a Word; what ever knowledge either the *Egyptians* or *Chaldeans* had of the *Stars*; certain it is, they referred it wholly to

lib. 6. Stromat.

Kk *Aſtronomantie*,

Aſtronomantie, or Divination by *Stars*: And therefore amon them there flouriſht, no true and genuine *Aſtronomy*, but a ſpurious and falſe one, *i. e. Aſtrology Divinatory*, or the fraudulent Art of *Fortune-telling* by the *Heavens*.

lib. 9. *cap.* 7. *lib.* 7. *cap.* 37. *Beroſus* (whom we formerly mentioned) coming into *Greece*, a little after the death of *Alexander*, is diſcovered to have brought with him nothing ſolid touching *Aſtronomy*, but only Judicial *Aſtrology* for which, as a thing new, and ſtrange to the People, he was highly eſteemed, as *Vitruvius* and *Pliny* remark. And *Eudoxus*, who had return'd out of *Egypt* before that, well knew what ſort of *Aſtrology* this was (the Principal Contrivers & Founders of which are ſaid to have been *Petoſiers*, *Necepſus*, *Eſculapius*,) 2. *de Divinat.* but he highly côntemned it, as *Cicero* remembers, and brought home no other Fruit of his tedious Travels, beſides a liſt of ſome *Eclipſes*; & the varieties of the Motions of the Wandring *Stars*, by which he firſt eſſayed to compoſe accommodate *Hypotheſes*, as we have formerly hinted. Nay, *Plato* himſelf, who was Companion to *Eudoxus*, for thirteen Years together, in *Egypt*, profeſt, that he could attain nothing ſolid and ſatisfactory, touching thoſe *Stars*, and therefore placed all his hope only in the ſagacity and induſtry of the *Grecians*, ſuch as he knew *Eudoxus* to be. *in Epinom.* "For, having firſt recounted what ever he knew concerning "them, he ſaith, it is to be believed that the *Grecians* make more "perfect whatſoever they receive from *Barbarians*; and there"fore it is fit, we allow the ſame, touching the Argument of which "we have diſcourſed. Truth is it is difficult to find out the way, "how all theſe Appearances, ſo involved in obſcurity, may be "explicated: Neverthele ſs, there is great hope that things of "that ſort will be better and more advantagiouſly Handled, "than they were delivered to us by *Barbarians*.

Articl. 6. *And after them to the* Grecians; *among whom the moſt ancient mention of Aſtr. is in* Heſiod.

From the *Egyptians* and *Chaldæans*, therefore (as *Aſtronomy* Her ſelf, while young and rude) we come to the *Grecians*; and the moſt Antique Records of *Syderal* Obſervations to be found among them, ſeems to be that of *Heſiod*; who in his Book of Weeks and Days teacheth Husbandmen the moſt opportune Times of Reaping, Sowing, and other Labours of Agriculture, from the Riſing and Setting of the *Pleiades*, and *Hyades*, and *Arcturus*, the *Dog-Star*, and *Orion*:

Πληϊάδων Ἀτλαγενέων ἐπιτελλομεν άων.
Donec Pleiades, qua & Atlantiades, exoviuntur, &c.

And I cannot tell, whether it were that Book, or ſome other, that *Pliny* meant, when ſpeaking of *Heſiod*, he ſays, *Hujus quoq; nomine extat Aſtrologia*, there is extant an *Aſtrology* of his. However, we are here to remark two Things, in order to our more exact diſquiſition; the *Firſt* is, that the Ancient *Greeks* principally attended to theſe Riſings and Settings, as well that they might diſtinguiſh the ſeveral Seaſons of the Year, as that they might fore-know Rain, Wind and other diſpoſitions of the *Air*, uſually attending theſe Seaſons. And hereupon, *Thalis*, *Anaximander*, *Democritus*, *Eudemon*, *Meton*, *Eudoxus*, and many others, compoſed certain *Parapegmata*, Tables (as *Ephemerides*, or *Diaries*) in which they inſcribe each Day of the Year, with the particular *Stars* Riſing or Setting on each Day, and what Mutations of the *Air* each one did portend. Such a *Parapegme* as theſe, was compoſed likewiſe by *Julius Cæſar* himſelf, for the *Horizon* of *Rome*; in alluſion whereto he might juſtly own, what *Lucan* ſaid for him,

Ex. Gem. Ptol. & aliis.

lib. 10.

lib. 1.

Nec meus Eudoxi faſtis ſuperabitur Annus.

And, him doubtleſs, did *Ovid* tranſlate into his *Faſti*: promiſing in the beginning, that he would ſing of the *Stars* and *Signs*, that Roſe and again Deſcended under the *Earth*. But, to keep cloſe to the *Grecians*; among them, he was held a great *Aſtrologer*, who had diſcovered and Obſerved only theſe Riſings and Settings here ſpoken of; and ſo of whom that might be ſpoken, which *Catullus* ſaid of *Conon*.

Omnia qui magni diſpexit lumina Mundi,
Stellarumq; ortus comperit, atq; obitus.

For, before the Advent of *Beroſus*, this was the only [*Epiſemaſia*] Præſignification or Divination by the *Stars*, the *Grecians* had among them: Unleſs what *Heſiod* hints, in his

In diebus.

Πρῶτον ἔνη τετράς τε, ἑβδόμη, ϗ ἱερὸν ἦμαρ,

Primum prima Dies, & qurata & ſeptima Sacra, &c.
where he points out, what Days of the *Moon* were accounted Lucky, and what Unlucky.

The *Second* Obſervable is, that among the *Grecians*, and indeed among divers other Nations, beyond all Memorials of either Traditions, or Books, the *Stars* were reduced to certain Images or *Conſtellations*, and denominated accordingly (as their Names yet ſhew) as it pleaſed the fancies of Husbandmen, Shepherds, Mariners and the like; who uſed to be vigilant and gazing upon the *Heavens* in clear Nights. Though there have been ſome *Conſtellations* added of latter Times, as that of the *Leſſer Wain* by *Thales*, which *Laertius* and *Tatius* recite out of *Callimachus*, who alſo took the ſame elſewhere, and that of *Berenices Hair*, removed into *Heaven* by *Conon*, as *Catullus* relates. *Cleoſtratus* likewiſe (as we have it from *Hyginus*) found out the *Kids*: though (which *Pliny* moreover attributes to him,) his invention of the *Signs* in the *Zodiack*, is ſo to be underſtood, as that he taught Men through what *Signs* the *Sun* and other *Planets* paſſed. But (that we may touch alſo upon this) at firſt the *Grecians* had only Eleven *Signs* in their *Zodiack*; and it was Long after ere they came to add the Twelfth, in imitation of the *Egyptians*, who (as may be collected from *Servius*, *Marcianus*, and others) inſtead of the *Clawes* of the *Scorpion*, placed *Libra*, the place deſtined to *Auguſtus*, by *Virgil*,

Lib. 1. de vit.
Iſagog. de Com. Beren.
lib. 2. Aſtron.
lib. 2. cap. 3.
in 1. Georg. l. 8.

---Ipſe tibi jam brachia contrahit ardens Scorpius.---

1. Georg.

They added the Twelfth, we ſay, to the end, that as the whole Compaſs of the *Zodiack* was divided into *Dodecatemoria* (as they call them) twelve equal Parts, ſo it might conſiſt alſo of Twelve Signs. Albeit, being (as it were) neceſſitated to make uſe of ſuch *Signs*, as had been brought up, rather by chance, than Art; thoſe twelve *Signs* were not exactly proportionate to the twelve Diviſions of the *Zodiack*, but took up more ſpace ſome, than others: as in particnlar, *Leo* poſſeſt more room than *Cancer*, *Taurus* than *Gemini*: I ſay, than *Gemini*, which though compoſed of *Caſtor* and *Pollux*; in ſo little ſpace as is allowed them, it is impoſſible the one ſhould Riſe, when the other Sets, and both in the *Eaſt*: but this *Empericus* interprets of the two *Hemiſpheres*. I omit to inſiſt upon this, that all Nations had not the ſame *Conſtellations*: as among the *Egyptians* was no *Bear*, no *Cepheus*, no *Dragon*, but other Forms or Repreſentations, as *Tatius* reports; and ſhall add only, that *Eudoxus* ſeems to

1. Adven. Phyſic.

to have been the firſt, who partly out of the *Egyptians* Figures, partly out of the *Grecians*, finiſhed the whole *Zodiack* with Images reſembling the *Aſteriſms* (as Men had fancied, at leaſt) and cauſed them to be drawn on a *Globe*, or ſolid *Sphere*. For, *Aratus* (upon whoſe Poem, intitul'd φαινόμενα, *Apparences*, there have been ſo many Commentaries ſet forth, as that no fewer than forty have been extant in *Greek*, beſides thoſe of *Cicero*, *Germanicus Avienus*, and other *Latin* Interpreters) did no more, but only expreſs in Verſe, what *Eudoxus* had ſaid before in Proſe, of this Argument; as *Hypparchus*, *Bythinus* demonſtrates. I know not whether it would be ſeaſonable for me, here to *Lib.* 1. *in Arat. Phæn.* advertiſe, that it is no wonder *Aratus* erred ſo groſly in many particulars; conſidering that (as it is written in his Life) he Living with *Antigonus Gonota*, in the quality of his Phyſician, and *Nicander* in the quality of his *Aſtrologer*, and both were good at Poetry: *Antigonus* commanded the Phyſician to give him a tryal of his Poeſie, upon an Argument in *Aſtrology*; and the *Aſtrologer* to give another of his, upon ſomething in *Phyſick*: delivering to the one, the Book of *Eudoxus*; and to the other, all that was extant of *Treacles*, *Antidotes*, or *Counter-poiſons*. So each Wrote of what he did not well underſtand. One thing I ſhall not forget; and that is, that the *Phœnomena* of *Euclid*, who Lived near about the ſame Time, and taught at *Alexandria* (as in the Memorials of *Pappus*) were quite of another kind, being *lib.* 7. indeed no other, but certain Principles of *Aſtronomy*, concerning the Figure of the *World*, and the Circles of the *Sphere*, and chiefly, that of the *Zodiack*.

But, to return back to the more Primitive *Greeks*, I remember *And next of* Thales *Mileſius.* I ſaid, that *Thales Mileſius* was accounted the Firſt, who after old *Heſiod* and *Homers* Days, enquired into the Order of the *Stars*. And certainly he was the Man, who among the *Grecians* may challenge the Palm, as to Antiquity; for, *Apuleius* calls him, *ut antiquiſſimus, ſic peritiſſimus Aſtrorum Contemplator*, and *Eudemus* in *Laertius* atteſteth, that this was the Opinion of *lib.* 1. moſt, adding moreover, that *Xenophanes* and *Herodotus* highly admired him, for that he had firſt predicted the *Eclipſes* and Converſions of the *Sun*; and that *Heraclitus* and *Democritus* witneſſeth as much. And whereas *Apuleius* further ſubjoyns, that he found out the Motions and Oblique Tracts of the Syderal Lights, *Pliny* aſcribes that to *Anaximan-*

der, a Diſciple of *Thales Mileſius* (whence he was ſaid *Rerum fores aperuiſſe*, to have opened the Doors of *Cœleſtial* Matters) and *Diodorus* to one *Oenopides Chius*: Which *Thales* could not yet be ignorant of the Obliquity of the *Zodiack*, when he had Written of the *Solſtices*, and *Equinoxes*; and had converſed a long Time with the *Egyptians* in their own Country, as *Laertius* remembers. Further it is dilivered to us, that among others, he predicted that notable *Eclipſe* of the *Sun*, which hapned in the time of the War betwixt the *Medes* and *Lydians*; which he could not do by any other Reaſon, but only becauſe, coming newly out of *Egypt*, he had Learned, that *Eclipſes* generally return upon the ſame Day after the ſpace of nineteen Years, and having taken notice of one that fell out nineteen Years before, he concluded that there would be one at ſuch a Time. Nor is there Reaſon why any ſhould think, that otherwiſe his whole Life might be ſufficient to Obſerve all the Motions of the *Sun* & *Moon*, as from thence to be able to invent all things neceſſary for the Calculation of Times of their ſeveral *Eclipſes*. *In vit. Dionyſ.* Moreover, it doth not appear, how by any other way, but that *Helicon Cyzicenus* came afterward to foretel that *Eclipſe* of the *Sun* (mentioned in *Plutarch*) for which he was ſo much admired by *Dyoniſius*, and rewarded with a Talent of Gold. Nor likewiſe, how *Sulpitius Gallus* could foretel that other of the *Moon*, which as moſt opportunely predicted to the *Roman* Army, then ready to joyn Battel with the *Perſian*, is ſo highly Celebrated not only by *Plutarch* and *Pliny*, but alſo by *Valerius*, *Quintilian*, and other Hiſtorians: For other Rule for the Calculation of future *Eclipſes*, there was none before *Hipparchus*, who invented Hypotheſes and Tables fit for that purpoſe. Beſides, what *Laertius* imputed to *Anaximander*, *Plinius*, as confidently imputes to one *Anaximenes*, an Auditor of his: (namely that he ſhould be the inventor of that *Gnomon*, by which the Converſions of the *Sun* or the *Solſtices* and *Equinoxes*, were indicated; and that he ſet up ſuch a one at *Lacedemon*.)

Hen of Pythagoras, *and his Diſciples.*

Near upon the ſame Time was it, that *Pythagoras* is ſaid to have firſt diſcourſed (though *Phavorinus* in *Laertius*, confers that Honour upon *Parmenides*) that *Lucifer* and *Veſper* was one and the ſame *Star* of *Venus*. Now, whether may we conceive, that he borrowed this of the *Egyptians*, from whom being taught, that not only *Venus* but *Mercury* alſo were carried round about the *Sun*, as their Center, ſo that one and the ſame might be both Morning and Evening-*Star*: Poſſibly, from thence he might take the hint of his Conjecture, that the *Sun* was the Center of not only thoſe two, but of the other *Planets* alſo, and conſequently of the whole *World*: And Moreover that the *Earth* it ſelf, as one of the *Planets*, moved about the *Sun*? For truly, this was an eminent and conſtant Tenent in his School; as may be underſtood, not only from *Ariſtotle* in the general, but alſo from *Laertius*, in particular of *Philolaus*, and from *Archimed.* of *Ariſtarchus*, both *Pythagoras* his Diſciples; that we may not rehearſe all thoſe many paſſages in *Plutarch*, concerning this Memorable particular; nor name thoſe, who held, that the *Earth* was not ſo much moved about the *Sun*, as dayly turned round upon an *Axis* of its own; as *Timæus*, a *Pythagorian* alſo, who is therefore by *Syneſius* eſteemed, after *Plato*, *the moſt excellent Aſtronomer.*

2. *de cœlo.* 13.
de Arenarnum

Philolaus.
Ariſtarchus.
Timeus.
De den ad pacu.
in Timæum.

Furthermore, in the next Age after *Thales*, or near upon, comes *Cleoſtratus* (the ſame who was believed to have deprehended the *Signs* of the *Zodiack*) and he, ſeriouſly remarking that the Intercalation, which as we ſaid was wont to be made every fourth Year, celebrated with the *Olympick Games*, did indeed reſtore the Motion of the *Sun* to the ſame Day again; but did not reſtore the Motion of the *Moon* till the eighth Year, or two *Olympiades*, in which the Intercalatory Days amounted to ninety Days, or three Months: He, we ſay, thereupon introduced, inſtead of the *Tetaeteris*, or ſpace of four Years, the *Octaeteris*, or ſpace of eight Years, which compleatly paſt, the *New-moons*, and *Full-Moons* would return again on the ſame Days. But, when in ſhort Time Men had perceived, that this Inſtitution failed them, in exactneſs of Computation; and that ſundry ways had been attempted to cure this uncertainty, at length riſeth up *Meton*; ſomewhat more Antient than *Eudoxus*, and he demonſtrateth from the *New-Moons*, and *Full-Moons Eclyptical*, that they did not return upon the ſame Days, till after full nineteen Years: And thereupon he became the Author of the *Ennea decæteris*, or *Period*, or *Cycle* of nineteen Years. In reſpect of which diſcovery, together with the *Heliotrope*, or *Sun-Dyal* he made at *Athens*, and ſome other the like Inventions, he was in eminent eſteem among the *Athenians*. But as concerning that *Period*, *Callippos*, familiarly acquainted with *Ariſtotle*, diſcovering it to be too Long by the fourth part of a Day, inferred that from four *Periods* one whole

After theſe ſucceeded Clleoſtratus.

Meton, *&c.*

Day ought to be detracted: and ſo erected a new *Period* or *Cycle* of Sixty ſix Years, or four times nine; at the end of which, one Day was to be cut off; and this was called the *Callippick Period*, and remained in Uſe for a long time together. After him, ſucceeded *Hipparchus*, who detecting this *Period*, to be yet too Long; demonſtrated that after four *Callippick Periods*, or three hundred and four Years, there would remain one whole Day too much. And in truth, the Experience of many ſucceeding Ages declared, that to this detraction of *Hipparchus*, nine or ten Years over and above were to be expected. However, it is worthy our Notice, that the *Period* of *Meton*, together with the Connection of it, applied by *Callippus*, was of long uſe in the Church, under the name of the *Golden Number*: though wanting the Application of *Hipparchus* his Correction: alſo, a miſtake of about four Days, relating to the *New* and *Full Moons*, crept into the Account, even from the Time of the *Nicene* Councel, which was one of the two main Cauſes of the Reformation of the *Kalendar* in the eighty ſecond Year of the laſt Age.

Articl. 7. Eudoxus, *who firſt diſcovered the neceſſities of manifold* Spheres.

And now we have an opportunity to ſpeak more expreſly of *Eudoxus*, ſo frequently mentioned. This man, well underſtanding after his Return out of *Egypt*, that not only the *Sun* and *Moon*, but alſo the five Errant *Stars*, did keep their Courſes round in the *Zodiack*; and ſo, as that as well the *Sun* and *Moon*, as thoſe wandring *Stars* did ſometimes vary their *Latitude*, or deviate from the *Ecliptick* Line in the middle of the *Zodiack*: (for, he thought the *Sun* was alſo extravagant, as well as the reſt;) and again, that the other *Planets* did not only go forward, but were alſo ſometimes upon their Retreat backward; and ſometimes made a Hault or ſtood ſtill: we ſay, pondering all thoſe various Motions in his Mind, and caſting about what might be the Reaſons thereof in Nature; he at laſt imagined to himſelf, that beſides the *Aplanes* or *Sphere* of fixt *Stars*, which being ſupream, carried all the reſt toward the *Weſt*, there ought alſo to be allowed three other *Spheres*, as well to the *Sun* as to the *Moon*, and four to each one of the other Errant *Stars*, of which one and that the Higheſt, ſhould follow the Impreſſion of the *Fixt Stars*, or rather of the *Primum Mobile*; the next to that ſhould move Counter to the Firſt, or toward the *Eaſt*; the third makes the deviation from the *Ecliptick*, or middle of the *Zodiack*; and the fourth, or loweſt, cauſe in the *Stars* their *Direction*, *Station* or *Retrogradation*, and that by a certain Vibration, or Waving to and agen. So that he ſuppoſed in all, twenty ſeven *Spheres*, and all thoſe Concentrical, that the Superior might carry on the Inferior, and theſe might be turned round within thoſe. Afterwards *Callippus* adjoyned two *Spheres* to the *Sun*, two to the *Moon*, and one a piece to *Mars*, *Venus*, and *Mercury*, and ſo made thirty there: And *Ariſtotle*, to all the *Spheres*, which did not follow the Motion of the *Aplanes*, or *Primum mobile* (excepting only the *Lunar Spheres*) added as many more, which he called the *Revolvent* ones, to the end he might conform them to the Motion of the Inerrant *Sphere*, or *Primum mobile*: and ſo in the whole he conſtituted Fifty ſix *Spheres*, foraſmuch, at leaſt as we can collect from his own context. Now all theſe, and even *Plato* himſelf likewiſe, thought that the *Moon* was the loweſt of all the *Planets*; next to her, the *Sun*: and above the *Sun* the five Wandering *Stars*: Nor indeed doth it appear, that *Archimedes* himſelf Living a whole Age or two after them, repreſented the *Planets* in any other, than this very Order, in that ſo famous *Sphere* of his. In which though *Claudian* tells us, that no more was repreſented, but only the Motions of the *Sun* and *Moon*;

Percurrit proprium mentitus Signifer annum, In Epigram.
Et ſimulata novo Cynthia menſe redit:

Yet *Cicero* adds other Motions, when ſpeaking of *Archimedes*, “ he ſaith; when he Collected together the Motions of the *Moon*, *De divinat.* “ *Sun*, and five Wandering *Stars*, he did the ſame as that God, “ who in *Platoes Timæus* framed the *World*, that one and the “ ſame Converſion might regulate ſundry Motions, moſt dif- “ ferent each from other in Slowneſs and Swiftneſs. But *Hypparchus* afterwards finding, that as well the *Sun* as the *Moon* and the other five *Stars*, did come ſometimes nearer to the *Earth*, and ſometimes again mounted up farther from it; and plainly perceiving that that particular Appearance could not poſſibly be explicated by thoſe *Spheres*, that were all Concentrical to the *Earth*: therefore, wholly rejecting them, he reſolved, that the Motions of the *Planets* were to be accounted *Eccentrick*; and though he could not himſelf determine each particular, he yet demonſtrated the *Way*, in which *Ptolomy* afterwards inſiſting, accompliſht the Invention. But before we advance further, we are to Commemorate two or three Perſons of Note, by whoſe Obſervations both *Hypparchus* and *Ptolomy* profited very much. One was *Timocharis*, who about three hundred Years before Chriſt, among other things relating to the Fixt *Stars*, Obſerved that that *Star* which is called *Spica Virginis*, doth antecede the Point of the *Autumnal Equinox*, by eight Degrees. And with him are we to joyn *Ariſtillus*, whoſe Obſervations of ſome thing about the Fixt *Stars Ptolomy* made great uſe of, in order to his Demonſtrating that the Fixt *Stars* never change their Latitude. Afterwards (ſcarce an Age) ſucceeded *Eratoſthenes*, who being *Library-keeper* to *Ptolomy Evergeta* the former, perſwaded him to ſet up the *Armillæ* in the *Porticus* of *Alexandria*; which *Hypparchus* and *Ptolomy* afterwards made uſe of; and himſelf among other things Obſerved, that the Obliquity of the *Zodiack* was of Twenty three Degrees, and fifty one Minutes; which account *Hypparchus* and *Ptolomy* conſtantly adhered to.

Ptolom. *lib.* 1. *cap.* 11.

Articl. 8. Hypparchus, *who firſt obſerved the places of the Fixt* Stars, *according to Longit. and Latitude*

Now that we may at length remember the great *Hypparchus*, who flouriſh't near upon an hundred and forty Years before Chriſt: truly, we find it no eaſie task to recount, how highly *Aſtronomy* was beholding to him. For, in the firſt place, Examining that foreſaid Obſervation of *Timocaris*, with ſome others, albeit he could not conceive them to be in all points exact, yet becauſe himſelf had found that *Spica Virginis* did not antecede the *Equinoctial* point by more than ſix Degrees, and the other *Stars* in the like proportion: He hence underſtood, that the Fixt *Stars* alſo were moved *Eaſtward* according to the *Zodiack*; and thereupon wrote a Book, of the *Tranſgreſſion of the Soliſtices and Equinoxes*. And, being that in his Time, as not long ago in *Tycho Brahes*, there appeared a certain *New Star*, he “therefore “came to doubt (to ſpeak the Language of *Pliny* concerning “him) whether the like happened often or not; and whether “thoſe *Stars*, that were thought to be fixt, had alſo ſome certain “Motion peculiar to themſelves. Wherefore (as the ſame *Pliny* “goes on) he attempted a task of difficulty ſufficient even for “the Gods themſelves, namely to number the *Stars* for Poſterity, “and reduce the Heavenly Lights to a Rule, ſo that by the “help of Inſtruments Invented, the particular Place of each one, “together with its Magnitude, might be exactly deſign'd: And “whereby men might diſcern, not only whether they diſappeared,

lib. 2. *cap.* 25.

“ peared, or newly appeared, but alſo whither they Removed “ their Stations; as likewiſe, whether their Magnitude Encreaſed, “ or Diminiſhed; leaving *Heaven* for an Inheritance for the “ Wits of ſucceeding Ages, if any were found acute and induſtrious “ enough to comprehend the myſterious Order thereof. “ And this was the firſt Time when the Places of the Fixt *Stars* were Obſerved and markt out according to *Longitude* and *Latitude*: And that *Catalogue* of the Fixt *Stars*, which he Compoſed, is the very ſame, which *Ptolomy* afterward inferred into his *Almagiſt*. In the next place, he denoted what poſitions ſundry *Stars* had in reſpect each of other: Whether they were poſited in a right Line; or in a triangular Form; or in quadrate or ſquare, &c. As is manifeſt even from *Ptolomy* himſelf. Further, tho' the Motions of *Sun* and *Moon* were already in ſome meaſure known; yet he made that knowledg much more exact. For, he did not only much Correct the *Calippick Period*, formerly ſpoken of, but alſo, having Collected a long Series of *Eclipſes* (namely, from the Time of thoſe *Babyloniſh* ones, in the Days of *Mardocempades*, down to thoſe Obſerved By himſelf, for full ſix hundred Years together) and remarking, that neither the like *Eclipſes* did Return on the ſame Days, after the ſpace of every nineteen Years, nor that after ſome recourſes of ten *Novennales*, or ten times nine Years, any ſuch *Eclipſes* happened at the times ſuppoſed; and that the Cauſe thereof conſiſted both in the various *Latitude* of the *Moon*, and the Anticipation of her *Nodi* or Knots, and her Eccentricity, by reaſon whereof her Motions to her *Apogeum* were found to be ſometimes ſlower, and thoſe to her *Perigeum* more ſpeedy: Therefore, we ſay, he comprehended and gave Reaſons for all theſe Difficulties, and compoſed certain Hypotheſes, and according to them, certain Tables, by which he could ſafely and exactly Calculate and Predict what *Eclipſes* were to follow, how great they were, and when. And this was it which *Pliny* remembred, when having ſpoken of *Thales*, and *Sulpitius Gallus*, he comes to mention *Hypparchus*, “ After theſe “ (ſaith he) *Hypparchus* foretold the Courſes of both *Luminaries*, “ for ſix hundred Years to come; comprehending the “ Months, Days, and Hours of Nations, and the Situation of “ Places and turns of People: His Age teſtifying that he did all theſe great things, only as he was partaker of Natures Counſels. For, it muſt be that *Hypparchus*, beſides the precife Times, when

lib. 7. cap.

ibid. cap. 1.

He corrected the Callipick Period, *& predicted future* Eclipſes, *for* 600 *Years together.*

ſuch *Eclipſes* were to be Viſible to the *Hor.* of *Rhodes*, or *Alexandria*, pointed forth alſo ſome Countries, & principal Cities, together with the Deſignation of the Months in uſe among them; as alſo the very Days and Hours when each *Eclipſe* would happen; and other Prædictions ſucceeding to *Rome*, in the Days of *Pliny*.

Again, it is well worthy our recital, that *Hypparchus* labouring with long Deſire both to conſtitute *Hypotheſes*, and reduce into Tables the Motions of the other *Planets*, or five Wandering *Stars*; and yet not being able to furniſh himſelf either from the *Egyptians*, or from his Country-men the *Grecians*, with any competent Obſervations reſpective to thoſe *Planets* (for while the places of the fixt *Stars* remained unknown, it was impoſſible any ſuch could be made) and again thoſe he had himſelf made, were of much ſhorter Time, than was requiſite for the eſtabliſhing any thing certain and permanent in that ſort: He therefore only digeſted ſuch Obſervations as he had recorded by him into the beſt Order and Method he could deviſe; and ſo left them for their Uſe and Improvement, who ſhould come after him, in caſe any were found capable of underſtanding and advancing them. And at length, by good Fortune, it ſo fell out, that thoſe his Obſervations came into the Hands of *Ptolomy*; who comparing them with his Own, and finding them Judicious and Exact, thereupon firſt began to erect both *Hypotheſes* and Tables of Motions fit for thoſe *Planets*: yet not without much timerouſneſs and diffidence; becauſe his Obſervations being but few, nor of ſufficient Time, he durſt not promiſe himſelf any certainty of his Tables for any conſiderable Spaces, or number of Years. But for more aſſurance let us hear his own ingenious Confeſſion in that point, “The Time (ſaith He) from whence we have the Obſervations of the *Planets* ſet down, is ſo vaſtly ſhort in compariſon of the greatneſs of *Cœleſtial* viciſſitudes, as that it renders all Predictions, that are for any great number of Years to come, infirm and uncertain. And therefore I judge that *Hypparchus* (that zealous lover of Truth) conſidering this difficulty, and withal receiving not ſo many true Obſervations from the Antients, as he bequeath'd to us, undertook indeed the buſineſs of the *Sun* and *Moon*, and demonſtrated that it might be performed, by Equal and Circular Motions: yet, as for that of the *Planets*, thoſe Commentaries of his which have come into our Hands, clearly ſhew, that he attempted

Almageſt. lib. 1. cap. 2.

“ tempted it not: but collecting all his own Obſervations con-
“ cerning them, together in one order and method, for their
“ more commodious uſe, reſigned them to the induſtry of after
“ Times, having firſt demonſtrated, that they were not congru-
“ ous to thoſe *Hypotheſes*, which the *Mathematicians* of thoſe
“ Days made Uſe of. And, for others, ſure I am, that either they
“ demonſtrated nothing at all, or elſe only attempted the buſi-
“ neſs, and left it unfiniſht. But *Hypparchus* being eminently
“ knowing in all kinds of Learning, conceived, that he ought
“ not (as others had done before him) to attempt, what he
“ ſhould not be able to accompliſh. So that we ſee, *Ptolomy* was the firſt, who from true Obſervations, reduced the Motions of the *Planets* into *Hypotheſes* and Tables correſpondent.

Articl. 9. *Betwixt* Hypparchus *and* Ptolomy, *came* Soſigenes *of* Alexandria, *by whoſe help* J. Cæſar *endeavoured the reformation of the Calendar.*

But before we ſpeak more particularly of him, who Lived about an hundred and thirty Years after Chriſt, foraſmuch as in the ſpace of Time betwixt *Hypparchus* and *Ptolomy*, theſe Studies ſo Flouriſht at *Alexandria*, as that *Julius Cæſar* returning thence, brought along with him that *Soſigenes*, by whoſe Aſſiſtance he endeavoured the reſtitution of the *Calendar*, and ſo may be thought to have propagated the Study of *Aſtronomy* among the *Romans:* Let us reflect a little upon that Time, and ſee what care they then had of *Cæleſtial* Matters In the firſt place, We are to lay aſide the Commemoration of *Sulpicius Gallus* (of whom more than once afore) as one that falls not under this account, concerning whom we may not yet forget, what *Cato* is induced by *Cicero*, ſaying, While we ſaw that *Gallus* Dye, that Familiar Friend of thy Father, *O Scipio*, who was reſtleſs in Meaſuring *Heaven* and *Earth*; I ſay, while we ſaw him Dying even in that Study; How often did Day oppreſs him, when he had ſet himſelf to Obſerve and deſcribe ſomething in the Night? and how often did Night oppreſs him, when he had begun his Speculations in the *Moon?* How was he delighted, when he had a long Time before predicted to us *Eclipſes* of the *Sun* and *Moon?* &c. For he was a Man clearly ſingular, and in an Age when ſo great Ignorance and neglect of good Arts tyrannized over Mens Minds, being himſelf Studious and Inquiſitive, could not but have borrowed his Skill either from *Egypt* or *Greece*, where having obtained a *Series* of *Eclipſes*,, and the Way of deducing them through the Circuit of nineteen Years (as we ſaid before) he became able to Calculate them, ſo as *Cicero* relates. For, as to the reſt; how great do you think was the Ignorance and neglect, nay even Contempt of Studies of this Nature among the *Romans*? Why truly ſo great, as that *Virgil* could not diſſemble it, in the Poeſy attributed to *Anchiſa*; according to which the *Romans* ſhould indeed come to Rule the *World*; but yet ſhould yield to others in Learning to know the *Stars*, and deſcribe the *Heavens*.

6. *Æneid.*

— *Cœliq; meatus*
Deſcribent radio, & ſurgentia ſidera dicent.

And *Cato* himſelf is cited by *Agellius* to have left in Writing, that it was not Lawful to Write what is in a Table kept by the High Prieſt: How often ſcarcity of Proviſion would happen; How often the Light of the *Sun*, or *Moon* ſhould be Darkned: So far, ſaith *Gellius*, did *Cato* contemn the Science of *Aſtronomy*, and thought uſeleſs either to know, or ſortel the *Eclipſes* of *Sun* and *Moon*. Furthermore, though from Times as high as *Numa*, the *Romans* made ſeveral Intercalations; yet they took all their Art of that ſort, from the *Greeks*: And *Pliny* Remarks, that in *France*, *Spain*, and *Africa*, there was not one Man, who could ſo much as tell the Riſing of the *Stars*. Nevertheleſs we are not to forget, that among the *Gauls* was one *Pythias*, the *Phyloſopher* (as *Cleomedes* calls him) of *Maſſilia*: Who about the time of *Alexander* of *Macedon*, found the Proportion of the *Gnomon* to the *Solſticial* Shadow, to be the ſame at *Maſſilia*, as *Strabo* tells us *Hypparchus* had Obſerved it at *Byzantium*; who firſt attempted the *Northern Ocean*, and Diſcovered the utmoſt *Thule*, in which *Cleomedes* coherently proves the Summer *Trophick*, to be the ſame with the *Polar*, or greateſt of always apparent ones: And who (as from his Book, *de Oceano*, may be inferred) was exceedingly curious to find out what was the Poſition of *Heaven*, reſpective to the variety of Countries and *Climates*. But, not ſo ſoon to digreſs from the *Romans*, *Pliny* delivers, that in thoſe firſt Times of *Romes* being a Common-wealth, the Invention of *Dials* was very Raw and Imperfect; For that they had only the Riſings and Settings named, out of Twelve Tables. That after ſome Years, they added the *Meridian*, and by the indication of a certain column, the laſt Hour: Nor that neither, but only in clear Weather, even as long as till the firſt *Punick* War. Afterward they

lib. 2. *cap.* 28.

1. *Meteor.* 7.
Pythias Maſſilienſius, *a* Gaul *and contemporary to* Alex. *of Maced.*

lib. 7. *cap.* 60.

they advanced ſo far, as to make one, on two *Sun-Dials*; but not with *Lines* exactly correſpondent to the Hours, until about an Age after, when *Q. Marcius Philippus* ordered the Buſineſs more diligently and ſucceſsfully. And, becauſe the Hours of the Day remained yet uncertain in Dark and Cloudy Weather, *Niſica Scipio* began to divide the Hours of Day and Night equally, by Water Diſtilling from Veſſel to Veſſel, and called it *The Dial within Doors*, in the Year *Urbis conditæ DXCV.* And till then, ſaith *Pliny*, *Populi Romani indiſcreta Lux fuit*. And thus much of *Hypparchus*, and ſome *Aſtronomers* betwixt him and the Prince of them all, *Ptolomy*.

Quintus *Marcius* Philippus, *&c.* Naſica Scipio, Romans.

Articl. 10. Ptolomy, *the true Founder of* Aſtronomy *in one intire ſtructure.*

And of him, ſo great is his Name, all we need to ſay, is only that he was the *very Founder of the Art*, or *Science of Aſtronomy*. For, tho *Hypparchus* had indeed, as it were hewn out the Stones and Beams fit for ſo Noble a ſtructure, and prepared good part of the Materials; yet was it *Ptolomy* alone who put them into Order and Form, and by adding many admirable Inventions of his own, by infinite Labour and Coſt, Erected that ſo famous Building, worthily called Μεγάλη Σύνταξις, *the great Co-ordination, Conſtruction*, or *Compoſition:* Which conſiſting of no leſs than thirteen Books, contains all the Doctrine, that could then be advanced, concerning the *Sun*, *Moon*, and as well the Fixt, as Wandering *Stars*. And, albeit one Day teacheth another, and that (as himſelf had truly foretold) there came others after him, who ſaw good cauſe for the Caſtigation and Correction of many things delivered in that Work: Yet, in the general, the Art he had inſtituted, remained Firm and Conſtant, and was afterwards imbraced, not only by the *Alexandrians*, but alſo by all the *Arabians*, *Latins* and others, who devoted themſelves to the Service of *Urania*, ever ſince. For, that the Study of her *Cæleſtial* Myſteries continued in great Eſteem and Veneration, at *Alexandria*, for ſome Ages after his Deceaſe, may be undeniably atteſted, not only from hence (but among others) both *Theon* and *Pappus*, named *Alexandrians*, were eminent therein; of which the one put forth eminent Commentaries upon *Ptolomies* Works, and the other, among ſundry excellent Pieces, of which his ſixth Book of *Mathematical Collections* is one, obſerved, that about four hundred Years from Chriſt, the *Obliquity* of the *Ecliptick* was not ſo great, as *Eratoſthenes*, *Hypparchus* and *Ptolomy* had conceived: But near upon the ſame we diſcover it to be in our

Who next reſigned it to Theon *and* Pappus, *both* Alexandrians.

Days: we ſay that this is not the only Monument that is extant of the Flouriſhing of *Aſtronomy* at *Alexandria*; long after *Ptolomy* had given it ſo great a Reputation there, but there remains another as Freſh and lively, which is the Memorials of thoſe *Patriarchs* of the *Alexandrine Church*, to whoſe Judgement the determination of that great diſpute about the true Time of *Eaſter*, was thought fit to be wholly referred; as well by the *Nicene Councel*, as by divers Learned *Biſhops* afterwads; and by *Holy Leo* himſelf, then *Pope* Now, among theſe *Patriarchs* were *Theophilus*, *Cyrillus*, and *Proterius*, whoſe advice and directions were thought neceſſary, in regard that the Controverſies raiſed about the Celebration of *Eaſter*, about the Time of the *Vernal Equinox*, about the *Full Moon* next following, and about conſtituting certain conſtant Rules reſpective to them; could not be better compoſed, than by the definitive ſentence of theſe Prelates, who Living at *Alexandria*, where *Aſtronomy* was in ſuch Height, had the advantage of Others, in point of knowing thoſe things which were requiſite to the finding out of the Truth. But, of the *Arabians*, who in the Study of *Aſtronomy* ſucceeded the *Alexandriaus*, and tranſlated into their own Language, the *Great Compoſition* of *Ptolomy*, which they called *Almageſtum*; the Firſt, and moſt worthy to be remembred, was *Albategnius*, otherwiſe called *Mahometes Aractenſis*, born of a Family of the *Dynaſtæ* of *Syria*; He about 800 Years after Chriſt, made divers *Cœleſtial* Obſervations, partly at *Aracta*, and partly at *Antioch*: and found both that the *Apogeum* of the *Sun*, ſince the Days of *Ptolomy*, was advanced to the following *Signs*; and that the *Stars* did regreſs toward the *Eaſt*, one Degree, not in the ſpace of a hundred Years, as *Ptolomy* alſo had deſigned; but of ſomewhat leſs than ſeventy: as alſo, that the Obliquity of the Ecliptick, according to *Pappus* his Theory, was leſs (*viz.* above 23 Degrees 35 Minutes) with many other particulars concerning as well *the Fixt Stars*, as the *Planets*: whereupon he both Corrected *Ptolomy* in many things and compoſed new Tables, and wrote a Book intituled, *De ſcientia Stellarum*. After him, within two or three Ages following, ſucceeded *Alphraganus*, *Arzachel*, *Almeon*, and other *Arabians*; among whom (as being already tainted with that ſuperſtition which had corrupted the ſimplicity of *Aſtronomy*, with *Aſtrological* Fooleries) ſome certain *Jews*, as ambitiouſly affecting the glory of Divination as the others, intermixed themſelves.

And long after, to Albategnius *then to*

Alphraganus *and other* Arabians.

After

Articl. 11. Alphonſus K. of Caſtile, who *made and named the* Alphonſine Tables.

After them, for a long time, the Worſhip of *Vrania* lay neglected, nor did *Aſtronomy* receive any the leaſt (conſiderable) advantage by Obſervators; till near about four hundred years ſince, *Alphonſus* King of *Caſtile* and *Leon*, being himſelf alſo toucht with the curioſity of *Aſtrological* predictions, and diſcovering that the Tables as well of *Ptolomy*, as *Albategnius* were not exactly agreeable with the Cœleſtial motions; ſet himſelf to the compoſing of new ones; & to that purpoſe convocated as many *Arab.* & *Jews* as were eminent in thoſe Days for *Aſtron.* employing them about Obſervations neceſſary to ſo great a Work, and comparing with them thoſe of their Predeceſſors, that ſo they might be the more exact in the performance of their task propoſed. And very memorable it is, that (as hath been credibly reported) He ſpent four hundred thouſand pieces of Gold on that undertaking: a munificence truly worthy the Heroick mind of ſo great a Prince, and which well deſerves to be had in perpetual commemoration by all lovers of Learning: but ſomewhat unhappily imployed, in reſpect the Perſons ſet a Work were not ſo ſtrict in ſtudiouſly and conſtantly obſerving, as ſcrupulouſly computing, directing their calculations not ſo much to what themſelves and others had really obſerved, as to certain traditional myſteries or Cabaliſtical dreams: that we may paſs by their heedleſsneſs, which *Regiomont.* detecting, perceived, that they had miſtaken the true places of the Fixt Stars, by very near two whole Deg. accounting the numbers of *Ptolomy*, as if they had heen conſtituted by him from the beginning of the Years of Chriſt. Which conſidered, we have the leſs reaſon to wonder, if the Tables compoſed by them, called from the Kings name, the *Alphonſine*, and ſometimes from the place, where they were made, the *Toletan Tables* (whence alſo He, who was Preſident of that aſſembly of *Aſtron.* is ſaid to have been one *Iſaac Chanter* of the *Toletan* Synagogue) have been found, ever ſince the time of K. *Alphonſus*, to diſagree with the Heavens, and to require the review and caſtigation of ſome new and more faithful hands. Thence forward *Aſtron.* lay neglected, and almoſt buried in Oblivion (only *Thebitius* an *Arab.* and *Prophalius* a *Jew*, obſerved in the mean time ſome ſmall matters, about the motion of the Fixt Stars, and the Obliquity of the *Ecliptick*,) until about two hundred Years ſince, *Georgius Peur-bacchius*, and *Joh. Regiomontanus*, his diſciple, ſeemed to revive it. For theſe worthy men delivered it out of the double cloud of ignorance and vanity, which the *Arabians* and *Jews* had

After whom the Science lay neglected, till, Georg. Peurbacchius *and* Joh. Regiomontanus *aroſe.*

and again cultivated the ſame.

raiſed to the Obſervations of its Luſtre; and kindled the Light thereof afreſh in *Germany:* reducing *Ptolomy*, providing Inſtruments, and making not a few faithful Obſervations: though they were not ſo Happy, as to bring their deſign to that perfection they hoped and had propoſed to themſelves; both of them dying in the middle and Flower of their Age.

Articl. 12. *Then followed the moſt acute* Nich. Copernicus, *who revived the Doctrine of* Pythagoras, *concerning the Earths motion.*

Animated by their example, *Nicholaus Copernicus* (a *Boruſſian* born, and *Canon* of the *Cathedral-Church* of *Wormes*, ſituate near *Fruemburgh*, in the ſame Country) about the beginning of the laſt Age, ſeriouſly addreſſed himſelf to the Illuſtration of *Aſtronomy*, and reviving the long neglected Syſteme of the *World*, excogitated by *Pythagoras*, he made many good *Obſervations*, in order to the compoſing of new Tables. But, foraſmuch as he could not determine any thing concerning the *Fixt Stars*, beſides their *Promotion Eaſtward*, which they appeared to have made ſince *Ptolomy*'s time; he therefore compoſed ſome *Canons* of their motions, and thoſe as exact as poſſibly he could: yet both thoſe, and the *Prutenick Tables* that were built upon them were incorreſpondent to the motions of the Heavens, though leſs incorreſpondent than the *Alphonſine*. Nevertheleſs, the man is to be highly commended, both for his ſublime perſpicuity, and modeſty, in that foreſeeing his *Canons* would need correction, he was wont frequently to exhort and encourage that ingenious young man, *Georgius Joachimus Rheticus*, deeply enamoured of the Beauties of *Aſtronomy*, to apply himſelf principally to the Reſtitution of the *Fixt Stars*, and chiefly of thoſe, which were in the *Zodiack*, or near it, and with which the *Planets* might be moſt conveniently compared: Becauſe, without their Reſtitution, it was impoſſible either to attain to the true Places of the *Planets*, or to atchieve any thing of Moment or certainty, toward the Advance of *Aſtronomy*.

Articl. 13. *And laſt of All, the noble* Tycho Brahe. *who out-did all the reſt in diſcoveries and inventions.*

And then at laſt enters that Noble *Dane Tycho Brahe*, upon the Theatre of *Aſtronomy*. Who (as he in the impulſe of his Genius) was addicted to Beholding and noting the *Stars*, even almoſt as ſoon as he ſaw the light of them; was ſo much the more ſpurred on by that advice of *Copernicus*, publiſhed in the Works of *George Joachim* newly mentioned, by how much the more clearly he diſcerned the impoſſibility of determining the true and proper place of that famous *New Star* (appearing in the *Conſtellation* of *Caſſiopea*, from the beginning of *Novemb.* in the Year MDLXXII. for above ſixteen Months together) without the reſtitution of the *Fixt Stars* to theirs. For, He plainly perceived, that moſt, if not all the Errors, which had been found in *Aſtronomy*, even from its firſt Foundation or Original, took their riſe chiefly from hence, that the *Fixt Stars* really were not in thoſe places, in which they were ſuppoſed to be by Obſervators; But ſome of them were much nearer, and others again as much farther off; and this, whether becauſe *Hipparchus* in the beginning had not with due exactneſs conſigned all the *Fixt Stars* to peculiar places, which indeed he had deſigned by the *Sextants* of Degrees (and truly it is very difficult at once to Invent any thing of Moment, and Perfect the Invention) or whether becauſe the Tranſcribers of *Ptolomy*, out of careleſneſs, or ignorance, had corrupted the Original Text in many places; or whether the Additions afterward made, in reſpect of the *Stars* progreſs to the following *Signs*, had occaſioned any miſtake and Imperfection in that Theory; or whether by any other unhappy Cauſe whatever. Now, in Order to this great Work, of Rectifying thoſe Fundamental Errors, it pleaſed the Fate, that about the very ſame time, that truly Generous and never enough Commendable Prince *W. Landgrave* of *Heſſia*, had zealouſly devoted his Mind and Induſtry to the ſame care, of reſtoring the *Fixt Stars* to their true Manſions: But yet the Honour he aimed at, was decreed only for the Incomparable *Tycho*; who in an Heroical bravery of Soul, had now reſolved with himſelf to enterprize no leſs than the Inſtauration of the whole Science of *Aſtronomy* from its very Fundamentals; and ſo to ſpare neither Labour, nor Coſt (eſpecially while he was ſo happy, as to have good part of his Expences Defrayed by the liberal Contributions of that Eminent *Mæcenas*, *Frederick* the II. King of *Denmark*, who thereby Recorded his Name in Immortal Characters on the Leaves of Fame) that would be neceſſary to the making all ſorts of Obſervations requiſite. As ſoon therefore as he had furniſhed himſelf with that *Aſtronomical* Colledge, or Tower for Obſervations, built by him in the *Iſland* of *Huenna*, to that purpoſe aſſigned him by the King, and furniſhed that *Heavenly* Cittadel by him called *Vraniburg*, with ſtore of Exquiſite and Magnificent Inſtruments Mathematical, he begun (having provided himſelf of ſundry Learned and Competent Coadjutors) exactly to Obſerve the *Altitude* of the *Pole*, in that Place, by the *Circum-Polary Stars*. By which underſtanding likewiſe the *Altitude* of the *Equator*, he pointed out the *Equinoctial* Points, by the paſſing of the *Sun* through them: And attending beſides to the middle parts of *Taurus* and *Leo*, he found out the *Apogeium* of the *Sun*, and the *Eccentricity* of it, and deduced its Courſe from the Point of the *Vernal Equinox*. Moreover, from *Venus*, in the Day time compared with the *Sun*, and in the Night with the *Fixt Stars*; he endeavoured to ſearch out the *Right Aſcentions*, & *Declinations* of the *Fixt Stars*: Which the Ancients had perform'd, but fallaciouſly by uſing the *Moon*, not *Venus*, to that purpoſe. And his Succeſs was as Exquiſite as his Care in this, that he Conſtituted that Bright *Star* which is in the Top of *Aries*, and ranged the chief of thoſe in order along the *Zodiack*: And then advancing to enquire or rather find out the diſtances of the reſt as well from them, as each from other, he defined both the *Right Aſcentions* and *Declinations* of all; preſcribed their ſeveral *Longitudes* and *Latitudes*, and added to the *Catalogue* of the Ancients about 200 other *Stars*, wholly by them omitted. Becauſe the Ancients, Living in an *Horizon* much more *Southern*, had Oſerved and ſet down near upon 200 *Stars*, that are Inviſible in the *Daniſh Horizon*, which is highly *Northern*: And *Tycho* again collected about 200 more than they could diſcern; and as being ſomewhat ſmall, he intermixed them among others of greater Magnitude. Further, having in the mean ſpace, always obſerved the paſſings of all the *Planets* through the *Merid.* and their ſeveral diſtances from the Chief *Fixt Sars* neareſt to them, he laid ſuch ſolid Foundations, as by them might be exactly known, not only the true places of each, but alſo their ſeveral Motions. So that he came very near the height of his noble hopes of Building the whole Theory of *Aſtronomy* anew from the very ground, and of Erecting Compleat & Everlaſting Tables for Calculation thereupon: But alas, prevented by an Immature Death, he could not accompliſh his deſign. It was very much, however, that he went ſo far, as to have Recorded and bequeathed to Poſterity ſuch excellent Obſervations, by which *Kepler* was ſoon after enabled to Compoſe an intire Theory, and make the Tables called the *Rudolphine*; and by which, and others afterward contrivable, whatever can be deſired in theſe Tables, may be fully ſupplied & perfected. And this among the reſt deſerves ſingular Commendations, that he left us the *Fixt Stars* re-inſtalled in their true manſions; wherein he alone, in few Years Practice, performed and finiſhed that prodigiouſly great Work, which no man from the Days of *Hipparchus*, had either attempted, or in any meaſure Advanced.

I paſs by many other admirable diſcoveries of his, as that he was the firſt who demonſtrated all *Comets* to be carried freely through the Ethereal Spaces; that *Refractions* ought to be carefully conſidered and allowed for, and how; that he perceived that the *Latitude* of the *Moon* ought to be augmented by more than a *Quadrant* or fourth part, than had been conceived; that he almoſt demonſtratively convinced the *Latitudes* of the *Fixt Stars* to be varied, that he excogitated an *Hypotheſis*, which all thoſe who cannot allow of the *Ptolomaical*, for fear to allow the *Copernican*, may well adhere to and defend: With many other things, as difficult in their Invention, as Excellent in their uſe. And Obſerve only, how vaſtly he tranſcended all that went before him, in point of exactneſs and certainty. As for *Inſtruments Mathematical*, it is well known, he made ſuch, as for the Condition of their Matter, for the Vaſtneſs of their Magnitude, for their variety of Forms, for the Care of their Elaboration, for the Preciſeneſs of their Diviſions, and for the Facility in Uſing, as the *World* had never the like before. Again, ſo prodigious was his and his Coadjutors ſubtility, diligence, induſtry; that whereas the Obſervations of *Hipparchus*, *Ptolomy*, and all others before him had been marked out only by the ſixth, or at the moſt by the twelfth part of Degrees; he deſigned all his by the ſixtieth parts of Deg. called *Minutes*, or *Scruples*, and very often alſo by ſubdiviſions of *Minutes*. So that we may well demand what compariſon can be made betwixt that groſs way found out by *Eratoſthenes*, and approved and followed afterward by *Hipparchus* and *Ptolomy*, for the Obſervation of the *Obliquity* of the *Zodiack*, and that moſt fine and Exact one Invented by *Tycho*? His being, by a Diviſion of the *Merid.* into 83 parts, and the Interval of the *Tropicks* deprehended to take up 11 of them, it appeared that the diſtance of one *Tropick* from the *Equator*, amounted to 5 of thoſe parts and a half, or by a reduction of them again to Degrees of 23 Deg. 51 Min. and $\frac{1}{3}$ parts, and theirs, being by an hollowed *Hemiſphere* of Stone, with a *Gnomon* Erected in the middle, as we have formerly deſcribed it; and to what Deg. of ſubtility and exactneſs this way of commenſuration could arrive, the meaneſt Novice in *Aſtronomy* may ſoon judge; That *Quadrant* likewiſe of *Ptolomy*, ſo much admired by

Ancient Authors; Pray how vaſtly ſhort did it come of the perfection of the leaſt that *Tycho* uſed? And the ſame may be ſaid of his *Rules*; for,that thoſe *Armillæ*,ſet up by *Ptolomy* in the entrance of *Alexandria* had any thing in them comparable to thoſe Erected by *Tycho* in his *Uraniberg*, cannot in the leaſt meaſure be argued from the other Inſtruments then in uſe. It is not neceſſary, we ſhould here again review thoſe Machinaments, or Engines, which the old *Egyptians* and *Babylonians* made uſe of, either in diſcerning the *Signs* of the *Zodiack* or taking the Diameter of the *Sun*: Or thoſe, which *Ariſtarchus* and *Archimedes* uſed, for commenſurating the ſame Diameter. Only we cannot but wonder, by the by, how *Ariſtarchus*, having aimed ſo near the white of truth, in the matter of the Suns Diameter, and determining it to be the 720*th* part of the Circle, or half a Degree; as is delivered by *Archimedes* ſhould yet err ſo widely in his Book of *Magnitudes* & *Diſtances*,as to make the Diameter of the *Moon* (which in truth is very near as great as that of the *Sun*)to be the 180*th* part of the Circle,or 2 Deg.when he called it *the Fifteenth Part of a Sign*; which miſtake of his was long ſince taken notice of by *Pappus*. Nor is there any neceſſity, why we ſhould ſurvey thoſe Inſtruments, that *Albategnius*,*Purbacchius*,*Reigiomontanus*,*Copernicus*, & other more modern *Aſtron.*uſed: conſidering,that beſides the *Rules* made by *Regiomontanus*(which *Bernardus Waltherus*,his Diſciple,preſerved,and had recourſe to, in his Obſervations of the Suns Altitude) they came ſo ſhort of the leaſt of *Tychoes*,in point of exact reaſoning,& amplitude,that they deſerve rather to be perpetually forgotten,than remembred to competition. However it is ſeriouſly to be wiſhed, that the Obſervations made by thoſe incomparable Inſtruments of His, may ly no longer concealed from the World (for by ſingular Providence they have been hitherto preſerved, as *Gaſſendus* atteſteth,*in the life of Ticho*)but ſoon be brought to Light. And this as well for ſundry weighty Conſiderations there alledged by *Gaſſ.* as for this,that not all the *Stars*,of which *Tycho* hath given a copious Catalogue in his *Progymnaſmata*, may be found reduced to congruous Calculation (in as much as they do not exactly correſpond with the Heavens) & that various Catalogues have been pretended from the ſame, which are very much different each from other: For all the difficulties hereupon depending may ſoon be removed, and all miſtakes rectified, by having recourſe to the Fountain, or Original obſervations, which will clearly declare what hath been already corruptly deduced, and what may be at length carefully and demonſtratively deduced from them.

And, in the mean while, if *Hipparchus* his memory be ſo highly and (indeed) juſtly precious among learned men, for his great merits in excogitating and framing Inſtruments, whereby to take the dimenſions, diſtances, motions *&c.* of Heavenly bodies: certainly, that of our *Tycho* ought to be as highly eſteemed by us and all Poſterity; ſince he alone, for ſo many Ages together was found, that durſt not only imitate him in thoſe ſublime inventions; but ſo imitate, as very much to exceed him. For my part, truly; ſince *Hipparchus* may rightfully be called *Atlas the Second*: I ſhall do but juſtice to name *Tycho*, *Hercules the Second*, who relieving his Predeceſſors, long languiſhing and ready to faint under ſo prodigious a burden; which doubtleſs was the Reaſon, why *Kepler* called him, the *Modern Hipparchus*.

And thus have we in a ſhort Relation, rehearſed to you, what we could gather together, concerning the Original, Progreſs, and Advance of *Aſtronomy*, from the higheſt of times, of which there remain any Authentick memorials, down to the deceaſe of *Tycho Brahe*, the Noble and the Great. As for what *Additions* this excellent Science hath received, by the induſtry of *Aſtronomers* in this preſent Age, by the help of the *Teleſcope*, whoſe Invention may ſeem to have been unhappily deferred too long, as being deferred till ſome Years after *Tycho*'s death: they may be eaſily ſummed up. For all that our Days can juſtly challenge the honour of diſcovering, is (1.) the ſpots in the Sun: (2.) the inequality of the ſuperficies of the Moon: (3.) *Venus* ſhifting her appearances, as doth the Moon: (4.) *Mercury* and *Jupiter* in ſome Proportion, doing the like: (5.) *Jupiter* with a kind of a bound about him, and guarded with four leſſer Stars as Attendants: (6.) *Saturn* tripple-bodied: (7.) the *Gallaxy* fully beſet with ſmall Stars: and (8.) divers pale aſſemblies of ſmall Stars ſeeming to be only little white clouds in the *Welkin*, with ſome other particulars lately remarked. Now if you pleaſe to add this to the former ſummary; you have the whole (though brief) Story of *Aſtronomy*, from its very infancy to that augmented ſtate it now hath attained: I wiſh I might have ſaid to its *Full growth and Perfection*. But, alas! that is reſerved for Poſterity.

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